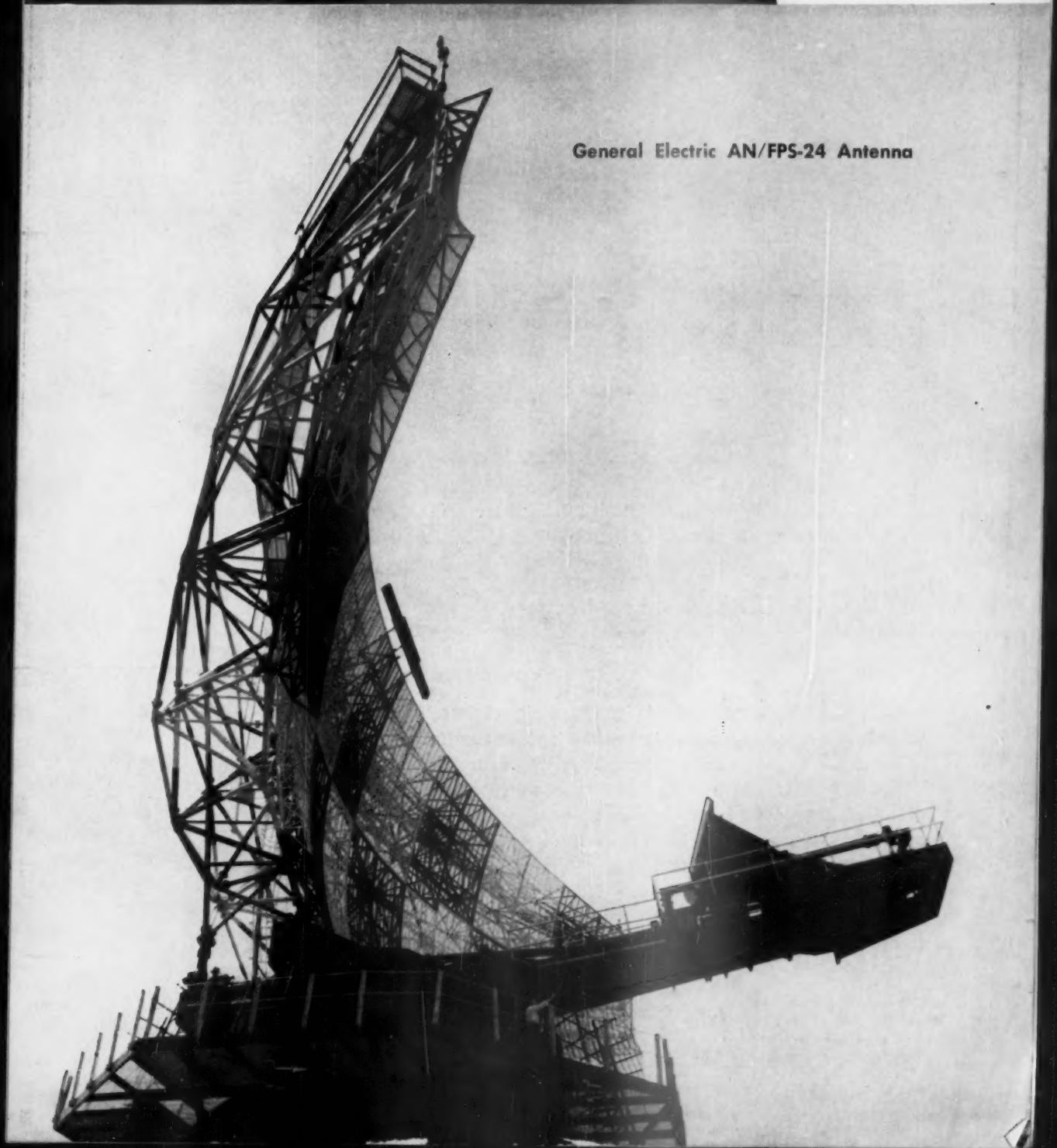
Aviation Week

Including Space Technology

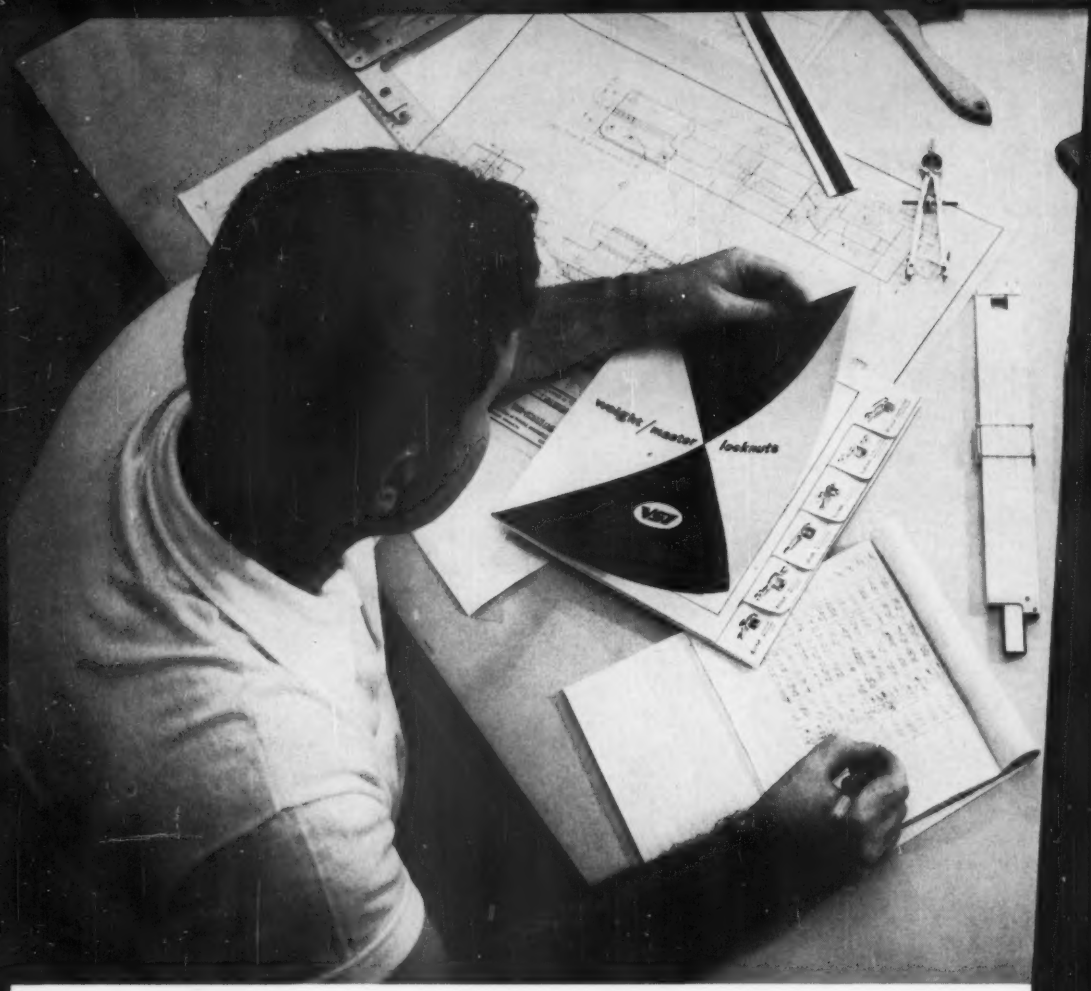
December 21, 1959

SPECIAL REPORT:

U. S.-Soviet Gains in Space



General Electric AN/FPS-24 Antenna



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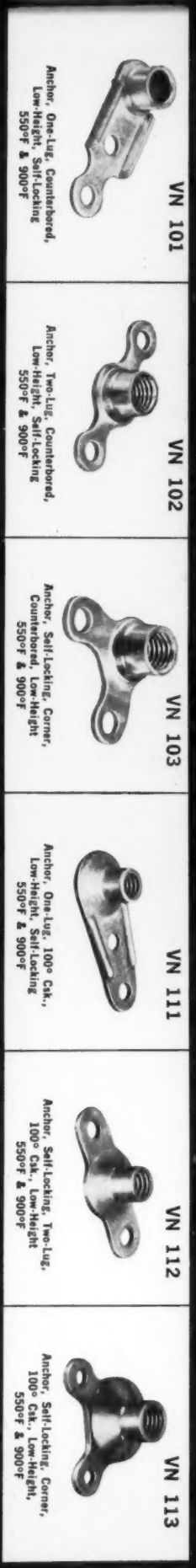
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AVIATION CALENDAR

Jan. 11-13—Sixth National Symposium on Reliability and Quality Control in Electronics, Statler-Hilton Hotel, Washington, D. C.

Jan. 11-15—1960 Annual Meeting, Society of Automotive Engineers, Sheraton-Cadillac and Statler Hotels, Detroit, Mich.

Jan. 12-16—16th Annual Technical Conference, Society of Plastics Engineers, Conrad Hilton Hotel, Chicago, Ill.

Jan. 18-20—12th Annual Convention, Helicopter Assn. of America, Disneyland Hotel, Anaheim, Calif.

Jan. 18-21—Sixth Annual Meeting, American Astronautical Society, Statler-Hilton Hotel, New York, N. Y.

Jan. 18-Feb. 5—Aviation Institute for Business Pilots and Commercial Carriers, University of Southern California, Los Angeles, Calif.

Jan. 20-22—Capitalizing on Technology, Special Research and Development Conference, American Management Assn., Roosevelt Hotel, New York, N. Y.

Jan. 25-26—Annual Meeting, Association of Local Transport Airlines, National Aviation Club, Washington, D. C.

Jan. 25-28—28th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 26.

Jan. 28-29—Solid Propellants Conference, American Rocket Society, Princeton University, Princeton, N. J.

Feb. 1-4—Winter Conference & Exhibit, Instrument Society of America, Rice Hotel and Sam Houston Coliseum, Houston.

Feb. 3-4—Sixth Annual Midwest Welding Conference, Illinois Tech Chemistry Bldg., Chicago, Ill. Sponsors: Armour Research Foundation of Illinois Institute of Technology; Chicago Section, American Welding Society.

Feb. 3-5—1960 Winter Convention on Military Electronics, Institute of Radio Engi-

(Continued on page 6)

AVIATION WEEK Including Space Technology

December 21, 1959

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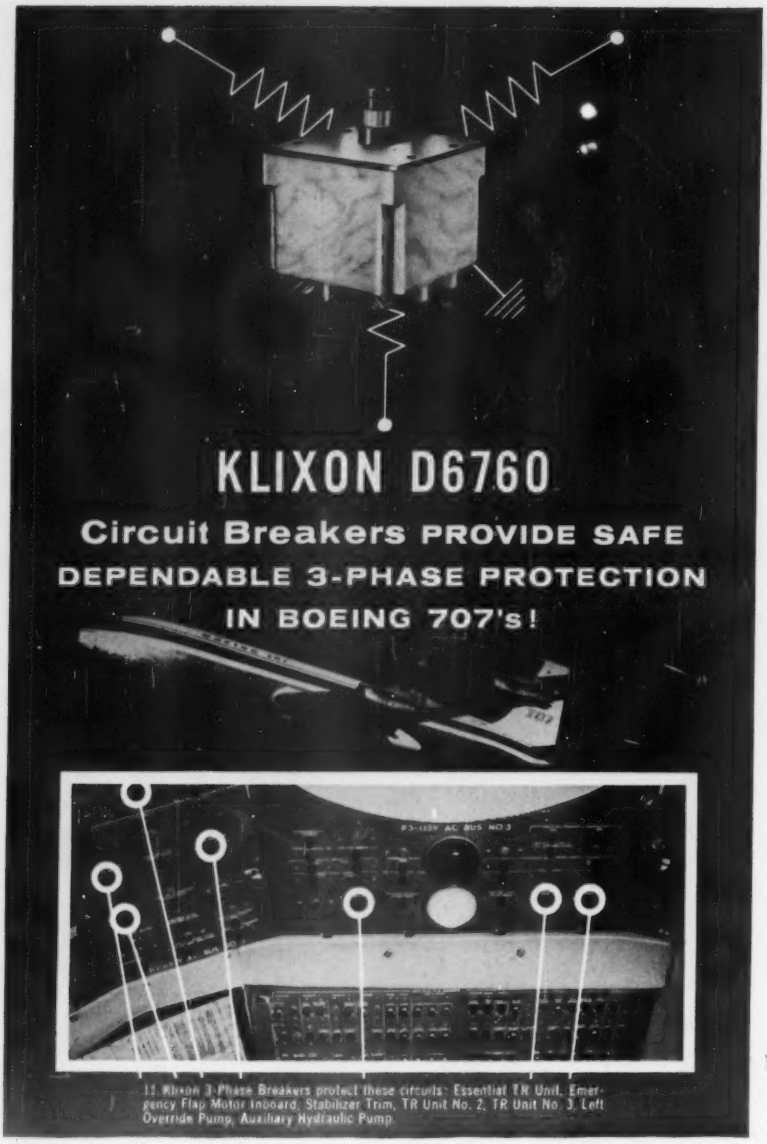

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AVIATION CALENDAR

(*Continued from page 5*)

neers, Biltmore Hotel, Los Angeles.

Feb. 10-12—Seventh Annual Solid-State Circuits Conference, Philadelphia, Pa. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; University of Pennsylvania.

Feb. 16-18—First National Symposium on Nondestructive Testing of Aircraft and Missile Components, Hilton Hotel, San Antonio, Tex. Sponsors: Southwest Section, Society for Nondestructive Testing; Southwest Research Institute.

Mar. 9-11—Conference on the Mechanical Properties of Engineering Ceramics, North Carolina State College, Raleigh, N. C. Sponsors: North Carolina State College School of Engineering; Office of Ordnance Research, U. S. Army.

Mar. 10-11—National Flight Propulsion Meeting (classified), Institute of the Aeronautical Sciences, Cleveland, Ohio.

Mar. 23-25—Symposium on Optical Spectrometric Measurement of High Temperatures, University of Chicago, Chicago, Ill. Sponsors: University of Chicago's Applied Science Laboratories; Jarrell-Ash Co.; National Science Foundation.

Apr. 6-8—Structural Design of Space Vehicles Conference, Biltmore Hotel, Santa Barbara, Calif. Sponsor: American Rocket Society's Structures and Materials Committee.

Apr. 6-8—1960 National Meeting "Hyper-Environments—Space Frontier," Institute of Environmental Sciences, Biltmore Hotel, Los Angeles, Calif.

Apr. 19-21—International Symposium on Active Networks and Feedback Systems, Engineering Societies Bldg., New York, N. Y. Sponsors: Polytechnic Institute of Brooklyn; Department of Defense Research Agencies; Institute of Radio Engineers.

Apr. 20-22 — National Symposium on Manned Space Stations, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif. Cosponsors: NASA; the Rand Corp.

Apr. 21-22—Southwest Metals & Minerals Conference "Metals and Materials for the Space Age," American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.

Apr. 25-29—41st Annual Convention and Exposition, American Welding Society, Biltmore Hotel and Great Western Exhibit Center, Los Angeles, Calif.

Apr. 27-28—National Meeting on Space Age Materials, Cincinnati Chapter of the American Society for Metals, Sheraton Gibson Hotel, Cincinnati, Ohio.

May 9-11—1960 Symposium of the Institute of Radio Engineers' Professional Group on Microwave Theory and Techniques, Hotel del Coronado, San Diego.

May 9-13—Second Southwestern Metal Congress and Exposition, American Society for Metals, Sheraton Dallas Hotel and State Fair Park, Dallas, Tex.

May 10-12—1960 Electronic Components Conference, Willard Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers' Professional Group on Component Parts; American Institute of Electrical Engineers; Electronic Industries Assn.; Western Electronic Manufacturers Assn.

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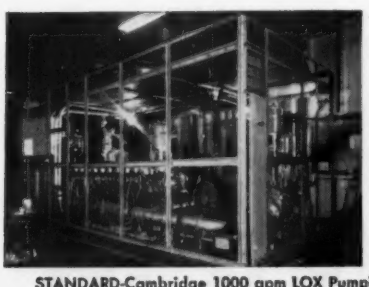

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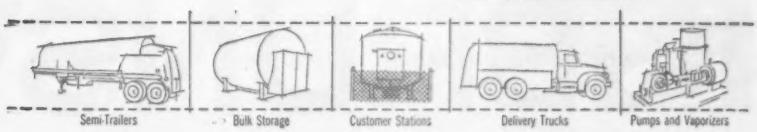

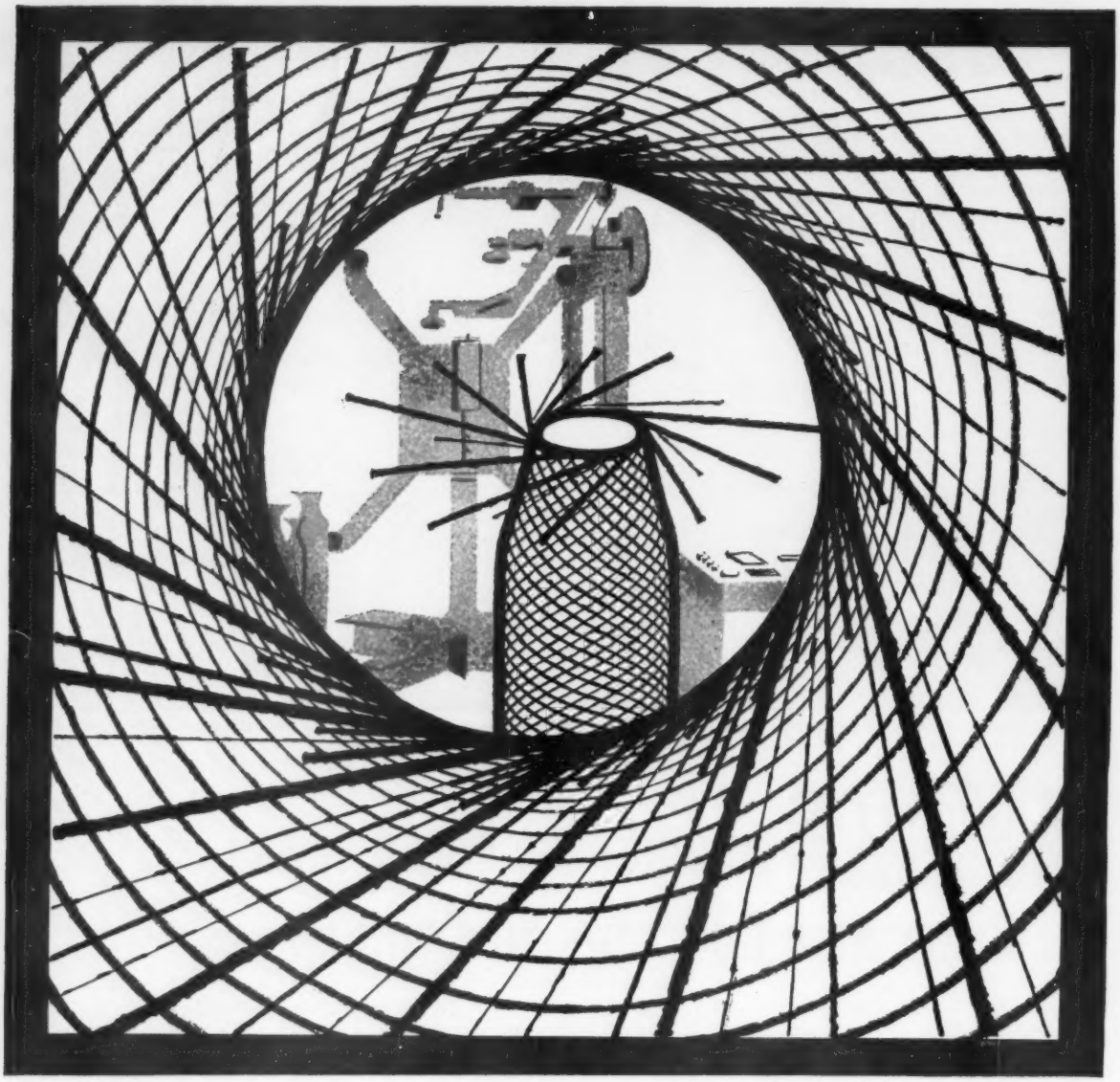

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NASA Kills Vega, Adopts USAF Agena..... 18
► Rocket vehicle is canceled after capability, cost comparison of unit with Air Force space vehicle.

Copilot Rules Will Be Bargaining Issue..... 27
► ALPA dissatisfied with FAA training regulation, will settle the question directly with airlines.

U. S., Russian Space Efforts Compared..... 36
► NASA's Dr. Homer E. Newell, Jr., details U. S. space accomplishments, in comparison with Russian programs.

SPACE TECHNOLOGY

NASA Kills Vega, Adopts Agena..... 18
Nuclear Space System Proposal..... 23
Johnson Raps Space Delay..... 26
U. S., Russian Space Efforts..... 36
Ehricke Asks Single Space Chief.... 50

AERONAUTICAL ENGINEERING

Mi-4S Enters Western Market..... 72
Belgians, Dutch Fighter Selection... 20
Bristol T.188 Design Details..... 22
C-130B Boundry Layer Control..... 25
USAF Sets Three New Records..... 24
X-15 Flight Aborted..... 26
CJ-805-3 Overhaul Plan..... 29

MISSILE ENGINEERING

Explosion Postpones Titan Tests..... 19
Regulus II Used as Drone..... 21
German-Developed Missile Ordered.. 23

AVIONICS

Computer Controls Resistor Production 55
B-52 ECM Cancellation..... 18
Motorola to Acquire LearCal..... 65
Lightplanes Avionic Installations.... 65
Filter Center 67

SAFETY

Debris Jams Elevator Control..... 87

AIR TRANSPORT

Copilot Rules to Be Bargaining Issue. 27
Engineer Training Dispute..... 28
BOAC Fare Cuts Approved..... 28
New Jersey Airport Hurdles 30
Il-18 Pushed in Foreign Markets.... 32
Allegheny 540 Cost Report..... 33
Shortlines 34
Airline Observer 34

MANAGEMENT

New ARDC Divisions Formed 21
French Stand Hampers NATO Posture 24
Accelerated Missile Effort Urged.... 68
Who's Where 15
Industry Observer 15
Washington Roundup 17
News Digest 26

EQUIPMENT

New Aviation Products 95

FINANCIAL

Chance Vought Mobile Homes..... 89
British Merger Plan..... 21
New Offerings 91
Financial Briefs 91

Calendar 5
Letters 102

EDITORIAL

Returning the Triple Crown..... 13

COVER: AN/FPS-24 high-power, long-range air defense search radar employs one of the world's largest rotating antennas, with reflector measuring 120 ft. wide and 50 ft. high. Reflector contains more than two miles of aluminum and steel tubing. Prototype radar, installed at Air Force site in Alabama for evaluation tests, was developed by General Electric's Heavy Military Electronics Department in cooperation with Rome Air Development Center. Antenna pedestal and feedhorn, supported on a 50 ft. boom, was manufactured by McKiernan-Terry Corp.

PICTURE CREDITS

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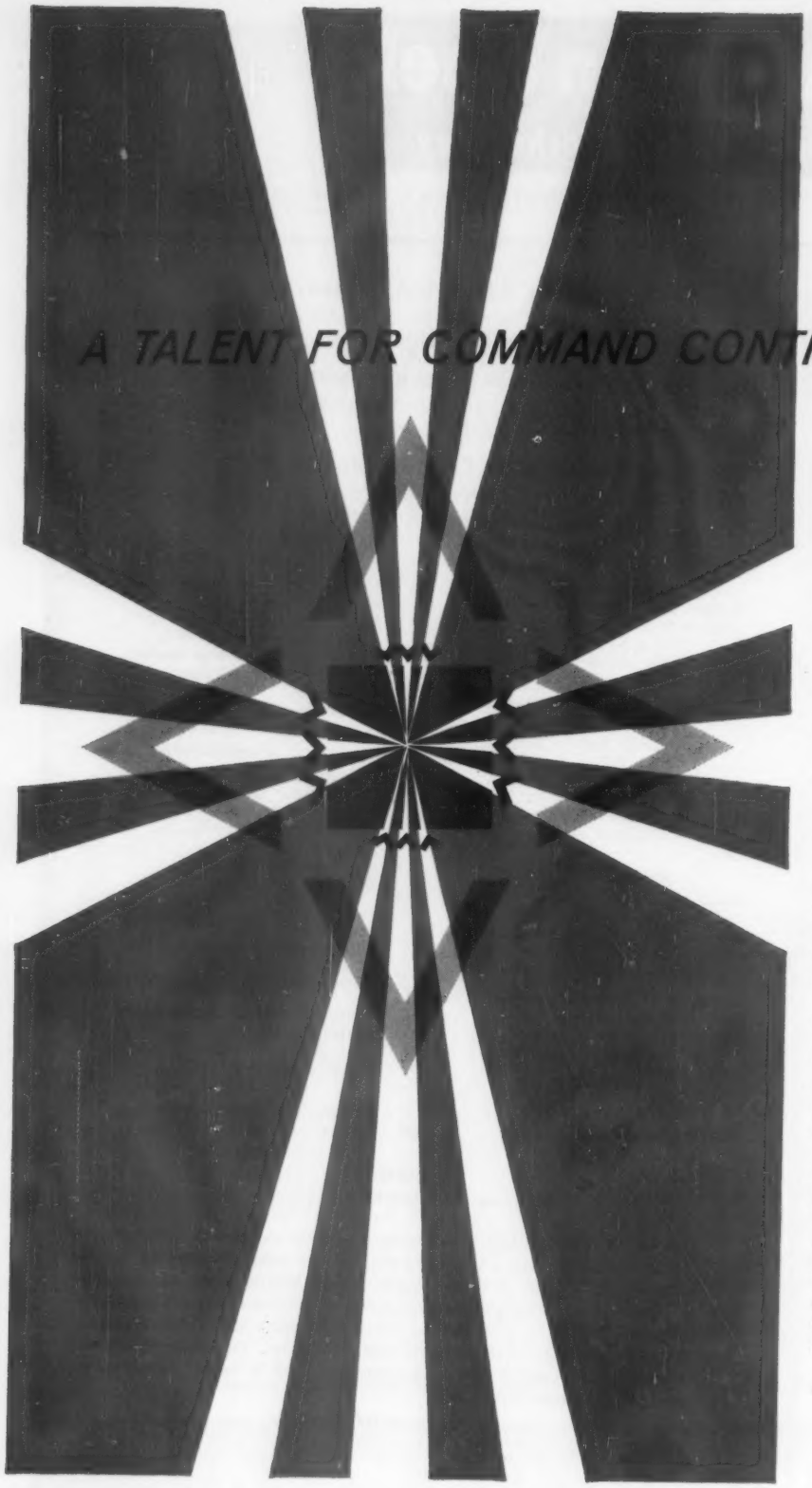

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EDITORIAL

Returning the Triple Crown

The last month of 1959 will have a permanent glow in the history of American aviation as the period when the triple crown of world records—speed, altitude and 100 km. closed course—returned to this country from France and the Soviet Union. This feat was accomplished by Air Force and Navy pilots in four different types of combat-ready aircraft that established a truly remarkable envelope of manned aircraft performance—1,525.9 mph. in level flight; 1,216.4 mph. around the 100 km. closed course and 103,395 ft. altitude. Even at the beginning of the "fabulous fifties" in aircraft development, it would have taken a rosy-viewed prophet to risk predicting what has in fact become reality in the final month of this decade.

The altitude record has been the most elusive in this triple crown for U. S. men and machines. It had reposed abroad for 28 years when USAF Capt. Howard Johnson returned it last year with a 91,249 ft. zoom in the Lockheed F-104. Last summer when we visited the Soviet Union for the Federation Aeronautique Internationale conference, Soviet designers Alexander Yakovlev and Sergei Ilyushin were extremely inquisitive about the absolute altitude capability of the F-104. The reasons for their interest in this subject were soon apparent.

Hardly a month after we left the USSR, that country made its first official bid in absolute world record competition with a 94,658 ft. altitude mark in a delta-winged jet fighter designated T431, apparently some special designation of the Sukhoi delta design that flew in prototype form at the 1956 Tushino air show. This Soviet record duly homologated as official by the FAI stood until early December when a McDonnell F4H carrier-based Navy fighter piloted by Cmdr. L. E. Flint topped it with a 98,560 ft. performance. This Navy mark lasted only a few days before Capt. Joe Jordan, a USAF experimental test pilot at Edwards AFB, took his F-104 to 103,395 ft. for a new peak. Capt. Jordan actually hit 105,000 ft. on one run, but sufficient recordings to meet official requirements were not obtained.

The speed record has been more at home in the U. S., although since World War II it has reposed occasionally abroad. Last month the Soviet Union entered this competition with a 1,484 mph. mark, apparently with the same type Sukhoi delta but this time labeled by the Russians as the E66. Although this mark was publicly announced in Moscow, it has not yet been officially filed with the FAI headquarters in Paris. And it will be interesting to see if the Russians really provide the full documentation on this performance required for official records. But, official or unofficial, this mark didn't last long either. Earlier this month a standard Convair F-106A flying at full combat gross weight averaged 1,525.9 mph. while piloted by Capt. Joe Rogers of USAF Air Defense Command. Capt Rogers is perhaps more familiar to readers of AVIATION WEEK as the pilot who flew our veteran pilot-engineering editor Robert Stanfield on a Mach 2 intercept described in our issue of Sept. 7, p. 126. Capt. Rogers' 1,525.9 mph. average speed is just below Mach 2.4 and was made during less than the best possible weather conditions. With better weather, the F-106 should be able to push this mark to just over Mach 2.5 and a position from which it should be difficult for anything but a stainless steel aircraft to wrest it. It is interesting to note that the Mach 2.5 capability of a USAF combat aircraft in operational service was demonstrated at about the same time that the British aviation industry disclosed construction of a stainless steel research aircraft designed to explore the speed range just above Mach 2.5 (see p. 22) and indicated first flight of this research aircraft would not take place until next year.

The 100 km. closed course record has also roosted in Britain and France during the postwar era, and there has been no attempt yet by the USSR to enter this competition. The 1,216.4 mph. performance by Brig. Gen. Joseph H. Moore in a Republic F-105B surpassed the old record held by a French Dassault Mirage 3A. Gen. Moore is commander of the Tactical Air Command 4th Fighter Wing, the first operational unit to be equipped with the F-105 Thunderchief and the subject of a major AVIATION WEEK story in our next issue.

As an added fillip, the Kaman H-43B turbine-powered helicopter wrested a class altitude record for helicopters from the Russian Mi-1 with a 30,100 ft. performance that found the two USAF H-43B pilots recording a minus 70 mph. groundspeed in the winds near their maximum altitude.

We have long supported keen international competition in all aviation categories as a healthy stimulus to technical advance and a fair measure of international technical prestige. We bitterly opposed the policies instituted a few years ago by the then-Defense Secretary Charles Wilson that virtually withdrew any modern U. S. aircraft from this type of competition and gave a wholly false international impression of our genuine capability in this field. We also urged the Soviet Union to join in this international competition (AW May 12, 1958, p. 21) and have been heartened by their recent willingness to compete. Many people, including our staff, are still puzzled by the confusing designation system applied by the Soviets to their record-breaking military aircraft. It would be a universal service if they clarified this point or at least released pictures of the record-breaking aircraft so that some common denominator could be established.

The day is rapidly approaching when these measurements of manned vehicle performance will extend out of the atmosphere and into space, posing many new problems both technical and political. The first, albeit unsuccessful, attempt to tackle these new problems was made by the United States delegation to the FAI conference in Moscow last summer. It is obvious that these attempts must be pressed vigorously if international aerospace competition is not to halt at the limits of the atmosphere.

In the meantime, a hearty salute to the U. S. military pilots who brought the triple crown back to this country and to Lockheed, Convair and Republic for manufacturing their combat-ready mounts.

—Robert Hotz

new

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WHO'S WHERE

In the Front Office

Lt. Gen. C. S. Irvine (USAF, ret.) will become a director of Houston Fearless Corp., Los Angeles, Calif.

Hugh S. Ferguson, a director, Miniature Precision Bearings, Inc., Keene, N. H. Mr. Ferguson is president of National Research Corp.

The Hon. John A. D. McCurdy, a director, Canadian Vertol Aircraft, Ltd., Arnprior, Canada.

G. L. Canfield, board chairman and chief executive officer, Altamil Corp., El Segundo, Calif., succeeding **William H. Brown,** who will remain as a director and consultant.

Russell C. Taylor, president, and **James F. Clark,** chairman of the executive committee, ACF Industries, Inc., New York.

Donald C. Stewart, president, Servomechanisms (Canada) Ltd., Toronto, Canada. Other appointments at the Canadian subsidiary: **Irving M. Liss,** director of engineering and sales; **George Kusonoki,** manufacturing manager; **John H. Pile,** chief of technical sales.

Kenneth M. Lord, vice president and general manager, Electronics Division, Stromberg-Carlson, a division of General Dynamics Corp., Rochester, N. Y.

T. Kenneth Greenlee and **William P. Lear, Jr.,** elected vice presidents of Lear, Inc., Santa Monica, Calif. Mr. Greenlee will be in charge of the Electro-Mechanical Division; Mr. Lear, director of European sales and service.

Robert J. Maroni, vice president-marketing, Defense Products Group, Daystrom, Inc., Murray Hill, N. J.

Alexander Black, vice president and general manager of Fruehauf Trailer Co., Detroit, Mich., has been named to head the company's newly established, integrated Missile Products Division, Los Angeles.

Robert J. Grenzeback, vice president-advanced engineering, Advanced Engineering Division, D. S. Kennedy & Co., with headquarters at the Monterey, Calif., laboratory of the division. Also: **Howard H. Hubbard,** manager of the Monterey laboratory; **C. M. Brown,** engineering manager; **M. E. Mower,** business manager.

Edward J. Green, vice president-planning and marketing, Westinghouse Air Brake Co., Pittsburgh, Pa.

Alfred Sansonetti, vice president-manufacturing, Avien, Inc., Woodside, N. Y.

Mrs. Anne L. Stanley, assistant vice president-passenger service, National Airlines, Inc. Also: **T. L. Boyd,** director of flight operations.

Dr. William Walton Carter, chief scientist, Army Ordnance Missile Command, Redstone Arsenal, Huntsville, Ala.

Dr. Richard Holbrook, formerly assistant chief of the Defense Analyses Branch, Institute of Missile Defense, Advanced Research Projects Agency, has returned to the Rand Corp., Santa Monica, Calif., as the associate head of the Operations Department, Engineering Division.

Edward L. Montgomery, executive assistant to the vice president and general manager of Aeronutronic, a division of Ford Motor Co., Newport Beach, Calif.

(*Continued on page 96*)

INDUSTRY OBSERVER

► Tactical Air Command is expected to acquire funds for an additional five wings of Republic F-105 fighter bombers in the Fiscal 1961 defense budget. Wing totals about 75 aircraft in three squadrons of 25 each plus attrition spares of up to eight planes per wing. Total production for the five wings could be as high as 415 aircraft.

► **Meanwhile, Air Force board of high ranking officers has been established to analyze aircraft programs projected for future USAF use and determine which should be downgraded in quantities and which should be eliminated completely. All major Air Force commands are represented on the board.**

► Messerschmitt proposal for a Mach 3 horizontal sitter VTOL design has a modified delta wing geometry, mounts six turbojets of 5,000 lb. thrust each. Two engines are installed in the fuselage for direct lift; the others are paired in rotatable nacelles at the wingtips for lift and thrust. Possible powerplant is the Rolls-Royce RB. 153. British have expressed an interest in the proposal, which is currently favored by the German working group responsible for advanced fighter designs. The Messerschmitt proposal is complementary to the Hawker P. 1127 transonic design (AW Sept. 28, p. 54).

► **Fiat Aviation Division has begun cutting metal for the first of 50 G.91R reconnaissance strike fighters for Germany. Special armament installation has been developed for the Germans built around a pair of DEFA 30 mm. revolver cannons replacing four Browning 50 caliber machine guns on the standard G.91 fighter version.**

► Operational versions of Navy-Bendix Eagle air-to-air missile probably will emerge with a range slightly in excess of 200 mi. Missile will be programed out to about 10 mi. from the target by a combination of shipboard and missile mid-course search radar. Pulse doppler terminal guidance will take over the final run to target. Present configuration is about 14 in. in diameter, approximately 15 ft. long.

► **Kaman Aircraft's Nuclear Division is analyzing all possible countermeasures that might conceivably be employed against a Polaris re-entry body under Navy Bureau of Ordnance contract. Study includes self-induced countermeasures and natural or other inadvertent countermeasures as well as those that might be used by a potential enemy.**

► Fourth shot in a continuing series of full-scale model Minuteman ICBM firings is scheduled this week from a test silo at Edwards AFB, Calif. Used to determine silo environmental factors, the missile model has a partially loaded first stage.

► **Initial flight testing of American Bosch Arma Corp. inertial guidance system in an Atlas intercontinental ballistic missile is scheduled to start in February. During the first flights, the Atlas missiles will be guided by General Electric/Burroughs ground-based command system with performance of the inertial system being monitored by telemetry. Subsequently the missiles will be guided by the inertial system.**

► Total of 61 Air Force-Douglas Thor missiles have been programed for space booster applications. Of these, 22 have been fired thus far—8 in the Discoverer series 14 in Thor-Able experiments. Latest Thors are using the 165,000-lb.-thrust Rocketdyne MB-3 Block II engine.

► **Study to quantitatively assess the probabilities of injuring portions of the civilian population during flight testing of ballistic missiles and space vehicles is being conducted by the Planning Research Corp. of Los Angeles for the Air Research and Development Command.**

► Cause behind a number of valve malfunctions registered in Air Force ballistic missile firings thus far has been traced to the basic valve design rather than to any manufacturing deficiencies. Over-all valve redesign may be made.

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Washington Roundup

Nike Zeus Funds Withheld

Office of the Secretary of Defense is withholding $137 million authorized by Congress for preproduction effort on the Nike Zeus anti-ICBM missile and reportedly has classified the reasons for the decision to prevent Army from making public protests. Approximately $15-20 million of the total was scheduled to be used to establish mechanized assembly lines for producing the millions of ultra-reliable transistors, resistors and capacitors needed for Zeus radars and computers (see p. 55, AW Nov. 30, p. 74). As recently as last June, the then-Secretary of Defense Neil McElroy recommended in testimony before the Senate approval of the funds added by the House "to accelerate further the Nike Zeus program."

Southern Transcontinental Proposals

Smaller trunklines would reap the greatest benefits if the Civil Aeronautics Board follows the course recommended by bureau counsel in the Southern Transcontinental Service Case. Counsel V. Rock Grundman proposed a complex of new routes which would create two new transcontinental carriers, and he advised the Board to abolish interchanges presently providing services across the southern U.S.

Grundman recommended these new routes:

- **Delta Air Lines** route beyond its present Ft. Worth terminal to Los Angeles and San Francisco.
- **National Airlines** route beyond its Houston terminal to Los Angeles and San Francisco via San Antonio and El Paso.
- **Continental Airlines** route between Houston and Los Angeles via San Antonio and El Paso.
- **Braniff Airways** route from its Ft. Worth terminal to Miami via New Orleans and Tampa.
- **Eastern Air Lines** route between Atlanta and Dallas/Ft. Worth via Jackson, Miss., and Shreveport, La.

Of the Big Four trunklines, only Eastern would benefit from these recommendations. American Airlines' monopoly routes between Texas and California would be burdened with competition from three of the smaller trunklines.

Anfuso Urges Space Teamwork

Rep. Victor Anfuso (D.-N. Y.), chairman of the International Cooperation Subcommittee of the House Space Committee, contributed to the campaign for a joint U. S.-Soviet effort in space last week with identical letters to President Eisenhower and Russian Premier Nikita Khrushchev. Anfuso told the two leaders:

" . . . it is not too difficult to visualize the early exchange of scientists who are specializing in the exploration of outer space, as well as an exchange of research information in this field. Similarly, the two nations can jointly undertake specific research projects of various kinds, such as the launching of satellites to sample certain physical phenomena of the universe, the establishment of joint tracking stations to keep flight articles under continued observation, joint operations in regaining control of space capsules returning to earth and their safe re-entry into the earth's atmosphere. Later, when man is introduced into the space environment, there could be joint logistic support for control and recovery operations . . . "

In a letter to T. Keith Glennan, administrator of National Aeronautics and Space Administration, Anfuso said he would support NASA's request for a bigger budget next year and asked that some of the money be used to expand NASA's international cooperation section because "money alone in an all-out race into space will not solve the problem. In such a race, without international cooperation, we could impoverish our nation, without attaining the peace and the strength we desire."

Soviet Discoverer Photo

Soviet Union, in turn, is publicizing that its cooperation with the U. S. in space has extended into the military area. A photograph of Discoverer V, a military satellite, taken by Vladimir Logovskiy of the Vologda Pedagogical Institute, was forwarded to the U. S. The Soviet press reported that Dr. Fred Whipple, director of the Smithsonian Astrophysical Observatory, Cambridge, Mass., has sent a reply "in which he warmly thanks" the Soviets for the observations.

Local Airlines Advertising Trades

Local service airline hopes to expand the scope of regulations permitting them to trade transportation for advertising were sharply curbed by the Civil Aeronautics Board last week. While granting a one year extension of the basic agreement, which also covers certificated intra-Hawaii and intra-Alaska carriers and tour operators, the Board emphasized that the purpose of the regulations is to provide the airlines a limited amount of relief from the full economic impact of advertising because of their "relatively limited funds" and dependence on subsidy. For that reason CAB rejected the carriers' request to raise the ceiling of the trade values from the present $100,000 to $150,000, noting that past annual values averaged about $68,000, and that the regulations were never intended to cover the full cost of the airlines' advertising programs.

Northwest Attacks PAA

Northwest Airlines opened its case in the Transpacific route hearings last week with a bitter attack on Pan American World Airways, charging that the carrier "dominates the U. S. flag international air travel industry as no other major U. S. industry is dominated." In his testimony before Civil Aeronautics Board Examiner William F. Madden, Northwest Vice President C. L. Stewart said that 60% or more of the industry's business is done by Pan American, and he added: "Moreover, it has ownership in more than a dozen other important international airlines . . . and is able to mobilize the resources of a worldwide network against its smaller competitors in local competitive situations." Stewart's testimony typified Northwest's over-all presentations, which were centered around the attack against Pan American for holding " . . . a monopolist's share of the market," as Northwest President Donald W. Nyrop described it. In essence, Northwest has set out to prove that Pan American "seeks to expand its route authorizations to duplicate Northwest's only routes to the Orient, while keeping its major exclusive routes, and obtaining for itself an even greater share of the Pacific traffic." —Washington staff

Space Technology

NASA Kills Vega, Adopts USAF Agena

Rocket vehicle is canceled after capability, cost comparison of unit with Air Force space vehicle.

By Evert Clark

Washington—National Aeronautics and Space Administration has canceled development of the Vega rocket and will use the Air Force-developed Atlas-Agena vehicle instead to perform Vega's space missions. This is the first large program canceled by NASA, and the action was taken "to reduce the number of rocket vehicles in the U.S. space programs."

First suggestion that the Vega be canceled in favor of the Air Force vehicle came from USAF itself. A comparison of costs and capabilities of the two vehicles reportedly was discussed by the Civilian-Military Liaison Committee, which is composed of Defense Department and NASA representatives, and later by the National Space Council itself, with the result that NASA was told to discontinue the Vega.

NASA hopes to gain some reliability by the action but does not expect to save much money or time. Military versions of the Atlas-Agena are scheduled to be fired before the vehicle is used for civilian space missions. This will produce a flight history for the vehicle and give launching teams experience.

The Vega project was initiated by NASA after the Advanced Research Projects Agency and Air Force had begun the Centaur project. Both Vega and Centaur use the Convair Atlas as a first stage. Centaur, with a hydrogen-fueled second stage, offered considerably greater payload lifting capability but was expected to require a longer time to develop.

Rather than help ARPA fund the Centaur, NASA proposed to get a vehicle more quickly by using modifications of off-the-shelf hardware—the Atlas plus the General Electric Vanguard engine. The Jet Propulsion Laboratory of the California Institute of Technology was to develop a 6,000 lb. thrust storable propellant engine for use as a third stage in later firings.

Vega Funding

Work on Vega was initiated last spring. Funding through Fiscal 1960 was $65 million. Some slippage occurred in schedules but a more important factor apparently was the success of the Agena stage in the Discoverer program. This stage is built by Lockheed Aircraft Corp. and powered by a 15,000-lb.-thrust Bell Aircraft Corp. engine originally designed for use in the Convair B-58 bomber pod.

Used as a second stage on the Douglas Thor, Agena has been fired eight times as the Discoverer satellite launcher and has performed successfully six times.

In this version, it weighs 1,700 lb. dry, 8,500 lb. wet and can launch a 600-lb. payload. Propellants are unsymmetrical dimethyl hydrazine and red fuming nitric acid.

The second stage to be used with Atlas for both the military and civilian missions, however, will be the Agena B, an engine with enlarged fuel tanks and a dual burning, or restart, capability.

The General Electric engine produced 28,000 lb. thrust at sea level and 31,000 to 32,000 lb. thrust at altitude in the Vanguard vehicle. For Vega, it had been modified to give the nozzle a 25-to-1 expansion ratio for altitude burning and to incorporate the start and restart capability. Although chamber size and flow rate remained the same, the high expansion ratio increased the thrust to 35,000 lb.

The Agena B will have approximately the same thrust. No models of the B have been delivered to USAF thus far. Early ones may be fired on the Thor vehicle. First shots of the Atlas-Agena may be with the Agena A, followed later by the higher-thrust B model.

B-52 ECM Canceled

Washington—Air Force last week canceled a contract for production of the B-52 electronic countermeasures system with Sperry Gyroscope Co. Air Force, which has spent approximately $142 million in development and initial production to date, hopes to save about $12-15 million in Fiscal 1960 funds originally planned for system production through the cancellation. USAF had earlier canceled the program, then reinstated it several days later (AW June 29, p. 29). Companies working with Sperry on the program include Kitel-McCullough, General Electric, Hallicrafters, IT&T Laboratories, Northrop, Radio Corp. of America, Sylvania and Thompson Ramo Wooldridge. Sperry says it hopes to limit its own layoffs to about 600 people through transfers to other projects.

NASA is expected to use only the B models, although some A models might be used in near-space missions.

NASA had ordered eight Vega vehicles—two next year, four in 1961 and two in 1962—and it is probable that it will use about the same number of Atlas-Agenas. Centaur may be available by the time the last of the NASA Atlas-Agenas are scheduled for flight, but military priority could affect this. Although development of Centaur was transferred from ARPA-USAF direction to NASA's booster program, the military requirements indicate that the first eight or nine will be used by the Air Force.

Vega, Agena Timetables

Under Vega's original timetable, it would have been ready before the presently-planned availability of Atlas-Agena B. Because of slips, Vega recently had been expected to be available in January, 1961.

NASA now says it expects to be ready to launch payloads with Atlas-Agena vehicles by late 1960 and that the payloads will weigh about the same as they would have with Vega. If the payloads are to weigh as much, the Agena stages would have to be B models.

Of the $65 million programed through Fiscal 1960 for Vega, some $15 to $17 million is not recoverable. The remainder of the money will be used for Atlas-Agenas and additional payloads, plus some research and development work on Centaur. The extra money for Centaur is not expected to speed up its schedule.

Lockheed will be the contractor for the Agena B stage. Vehicles probably will be bought through Air Force's Ballistic Missile Division. Payloads for deep space missions will be handled by Jet Propulsion Laboratory and those for near space missions by the Goddard Flight Research Center. Vehicle development will be supervised at the headquarters level by NASA's new Launch Vehicle Programs Office under USAF Maj. Gen. Don R. Ostrander (AW Dec. 14 p. 26), and, at the field level, is expected to involve the present Army Ballistic Missile Agency development team, which will be transferred to NASA.

Most prominent casualty of the cancellation is the GE engine, although JPL's 6,000 lb. storable engine may not be developed much further. The JPL engine is now being static tested at Edwards AFB. NASA refers to it as an "advanced development project" since the cancellation, and the agency said the number to be built and their

disposal has not been settled. The engine was not scheduled to be ready before 1961, and it is possible that it will not be used with any launching vehicle.

One GE engine is undergoing preflight readiness tests now and was expected to be ready for delivery on schedule next month, with two more engines ready as back-ups. Ten were to have been built. About 80% of the hardware work had been done, and every milestone date had been met. Some $4 million of GE's $5.1 million contract will not be recoverable.

The engine had undergone some 20 start-restart tests at simulated altitude in tunnels at NASA's Lewis Research Center. Burning time for the engine is a total of 250 sec., interrupted by a coasting period. Engines had been started, stopped for 90 min. and restarted. It had the capability for restart after as much as an eight-hour coast.

Engine would have used a hydrogen peroxide attitude control system for reacquisition of fuel for restarting. GE expects to go ahead with several growth plans for the engine, including use of storables and increasing thrust through the high expansion ratio method, using its own funds. NASA said it cannot conceive of any application for the engine now. GE expects some layoffs of personnel to result from the cancellation.

Construction has begun on Complex 36 at Cape Canaveral, Fla., which was to have been the Vega launch pad (AW Dec. 14, p. 67). Vega required a 166 ft. gantry, compared with the 115 and 130 ft. gantries now in use for Atlas-boosted vehicles. Plans called for the complex to incorporate facilities for handling advanced fuels, indicating it might be used for Centaur launchings as well. Construction of the complex is expected to go ahead, although some design changes may be made.

Vega was to have had the capability to put 5,800 lb. into an earth orbit; 740 lb. into a 22,000 mi. orbit; and 980 lb. into orbit around the moon. Missions proposed for the vehicle either in its two-stage or three-stage configuration included soft-landing 430 lb. on the moon; hard-landing 650 lb. on the moon; putting a television scanner into orbit around the moon; putting a 5,000 lb. meteorological satellite into a 300-mi. orbit around the earth; putting experimental communications relay satellites into a 22,000 mi. orbit; putting a two-man capsule into an earth orbit that would last for a week or more; sending 1,300 lb. to the vicinity of Mars and Venus; putting payloads into orbit around those two planets; and attempting entry into the atmospheres of Mars and Venus.

NOSE of Titan ICBM is visible as the missile explodes on its Cape Canaveral, Fla., pad.

Explosion Postpones Titan Tests

Washington—Further attempts to launch an Air Force Martin Titan to test second stage propulsion were postponed temporarily last week while engineers attempted to pinpoint the cause of the explosion of a Titan C on its pad at Cape Canaveral, Fla. A faulty relay in the safety destruct system is believed to have triggered the explosion.

Last model of the B lot, the B-7A, has been static tested and had been scheduled for launching three days after the C which exploded. Second C model was due to follow the B-7A launching by a few days.

Data reduction and tests of similar relays had not determined by late last week whether the destruct relay failed itself or whether some other action caused the relay to close.

Safety system consists of a command receiver, the suspected relay, and initiators which set off a primer cord running along the sides of the fuel tanks. The system is supposed to function only upon a command signal from the range safety officer and only in flight. The command receiver triggers the relay, which actuates the initiators. The relay from Titan C was recovered.

Missile's engines had ignited and had burned for almost exactly four seconds. It should have achieved liftoff at just under four and a half seconds. Explosive bolts that release the missile from its launch stand are supposed to fire within milliseconds of the time that the relay activated the explosion, so a possibility existed that shock caused by the bolts might have closed the relay.

Destruct system is the same one that has been on all Titans. USAF specifies how it wants a destruct system to work and Martin designs it and installs basic parts of the system on the missile at the factory. Initiator squibs and primer cord are not installed until the missile is at Cape Canaveral. One of the final prelaunch steps is manual turning of an arming pin in the initiator.

The Titan destruct system has not been tested in flight, although some other missiles have been destroyed deliberately, and this probably would have been done on a Titan flight after test objectives for that particular shot had been completed.

Zeus Test Launch

Washington—Nike Zeus anti-ICBM missile test vehicle was launched by Army at White Sands Missile Range last week, but the second stage failed to ignite. The vehicle, the third to be fired since tests began last summer, was intended to evaluate structure temperature and erosion, the Army said. Missile flew an unguided ballistic trajectory with its guidance fins in locked position. For configuration of test vehicle, see the Nov. 2 issue of Aviation Week (p. 30).

Belgians, Dutch Weigh Fighter Selection

By David A. Anderton

Geneva—Final selection of an all-purpose airplane re-equipping Belgian and Dutch air forces is expected in January, AVIATION WEEK has learned. The choice is believed to be between the Lockheed F-104 Starfighter and the Dassault Mirage 3.

The prospective order is for approximately 400 complete aircraft plus support equipment and spares. One authoritative estimate is 170 Belgian and 200 Dutch. The new airplane is to be capable of three major missions: attack, reconnaissance and interception. It will replace all Republic F-84F fighter-bombers, North American F-86K all-weather fighters and Hawker Hunter day fighters now in service for both of the forces.

Official spokesmen for both services emphasize no final choice or decision has been yet made and no intergovernmental agreement exists. Such agreement must precede mutual selection equipment, they added.

Both countries made engineering and pilot evaluations of available foreign aircraft. The Dutch officially named the Starfighter and Mirage 3 in early December. The Belgians are reported favoring the Mirage 3 but have made no official comment.

Unofficially, both countries are annoyed at premature reports identifying one airplane or another as favored or selected. They feel such stories are inspired by the manufacturer involved. Like most European countries, Belgium and Holland resent anything resembling external pressures. Conventional American sales techniques, including press conferences, are regarded with some suspicision.

The final choice is bound to be made for a combination of military, political and social factors with major emphasis on financing the purchase. Both countries assume Americans will help with easy payment terms if an American plane is bought, but both are uncertain how far the Americans are prepared to go. The French are reported to be offering easy terms for the Mirage.

The Belgians are having major budgetary problems meeting defense costs and the entire defense establishment is now undergoing careful scrutiny for reduction of expenses. Purchase of new equipment is a major share of future budgets and the Belgians probably are placing financial considerations highest on the list of factors.

Small Industries

Another major factor is that both countries have small but vociferous aircraft industries employing considerable numbers and for political and social reasons they want to keep these industries alive. The chosen airplane probably be built partially by both countries and terms for doing this could affect final choice.

In case of the Starfighters, negotiations are being conducted on a government-to-government basis and the price is not available. However, recent German orders for the F-104G indicate the unit price of a complete airplane, equipped and with spares, approximates $1.6 million figure (see box below).

West Germany holds license rights for Western Europe on the F-104G version, which would be practically identical with the Belgian-Dutch Starfighter. If the Dutch were to order the plane, total European production would approximate 1,000 units and costs could be reduced considerably. The Belgians and Dutch are free to negotiate either with the Germans or with Lockheed directly because the Germans have waived license rights for the G version in this instance.

Recent talks between the Dutch Defense Minister, S. H. Visser, and West German Defense Minister Franz Strauss, presumably aimed at reaching some pricing concessions on the purchase of Starfighters from Germany, have not shown progress, say Dutch sources, and the most recent offer from the French has taken on new significance.

The French are reportedly offering the Mirage 3 at a price about $200,000 cheaper than the F-104, with easy terms for payment and license rights for manufacture of most of the complete Mirage weapon system: airframe, engine and avionics gear. Under this proposal, Fokker in Holland would build up to 95% of the airframe, Belgium would build the Snecma Atar engine, and Phillips in Holland would handle production of avionic equipment.

Reports are that the French are trying to strengthen their aircraft industry and are willing to negotiate as far as it is possible to do so. This market is one of the few left for sale of any modern military aircraft, and French orders for the Mirage 3 still total only a few hundred, considerably under the number of Starfighters to be built, for example. French representatives have been plugging the idea of a strong European aircraft industry, in which their own would naturally play an important part. The recent sale of four Sud Aviation Caravelle Mk. 6 transports to Sabena, the Belgian airline, with an option of four more (see p. 28), is regarded as related to this problem of military aircraft procurement, possibly through terms granted by the French to the Belgians.

Republic Aviation Corp. has made a strong drive to get its F-105 fighter-bomber accepted. It is locally regarded as no coincidence that the F-105 just took the world's closed-course speed record away from the French Mirage 3 (see p. 24).

Republic has proposed European production of a major part of the F-105 weapon system and is quoting a current price of about $1.4 million per unit,

Germans Re-Order Lockheed F-104s

West German Defense Ministry has confirmed government approval to purchase another 364 Lockheed F-104G Starfighters in addition to the 296 F-104s for which a contract previously was signed in Bonn (AW Feb. 16, p. 33). Cost of the 364 Starfighters is roughly $600 million.

At German Defense Ministry's request the F-104G has been developed for multi-purpose duty as an interceptor, fighter bomber and reconnaissance plane. Negotiations are continuing and a decision is expected to be reached shortly on whether part or all of the 364 aircraft are to be produced under license in Germany.

Of the 296 F-104s purchased last February, 200 are now being produced under license in Germany. Of the 90 bought directly from Lockheed, 30 trainers are scheduled for delivery beginning in May and lasting until October-November, 1961. The remaining 66 airplanes are scheduled to become operational by the mid-1961.

Powerplant is the General Electric J79 turbojet engine. The Starfighters will replace the Republic F-84F and North American F-86 type aircraft still in service with the German Luftwaffe.

Simultaneously, the ministry confirmed government approval to purchase Martin TM-71 Mace missiles costing about $115 million. Subject to further negotiation and agreement between the U. S. and German defense authorities, the Germans propose to equip several battalions with Nike missiles with atomic warheads. The formation of one Hawk battalion also is under consideration.

Present strength of the German Luftwaffe is 57,000 officers and men which the Defense Ministry aims at stepping up to between 85,000 and 100,000.

British Merger

London—De Havilland Aircraft Co. shareholders will be asked to approve the company's acquisition by the Hawker Siddeley Group. A takeover bid submitted by Hawker Siddeley follows demands by Minister of Aviation Duncan Sandys that the industry regroup into two major airframe companies and two engine companies (AW Dec. 7, p. 35). Earlier discussions between Hawker and Blackburn apparently have been abandoned (see p. 89).

To effect the merger, Hawker Siddeley is making a cash-and-share offer for de Havilland stock worth approximately $39.8 million at current market prices. One Hawker Siddeley common share ($2.80) would be offered for each de Havilland common share ($2.80). Three Hawker Siddeley 5½% $2.80 preferred shares and $2.80 in cash will be offered for every four de Havilland 5½% $2.80 preferred shares.

not including spares or ground equipment based on European production of 250 aircraft.

Both countries plan to replace all current fighter-bomber and fighter-interceptor squadrons with units built around a single airplane. Similarities in military problems and planning prompted consideration of re-equipment cooperation.

New ARDC Divisions Formed

Washington—Air Research and Development Command officially activated Ballistic Missile Division and Wright Air Development Division last week as two of the four new divisions to be formed under ARDC's reorganization plan.

In the reorganization pattern (AW Oct. 12, p. 33), BMD will retain its role as manager of ballistic missiles and space systems, and relations with Air Materiel Command Ballistic Missile Center will remain the same. Maj. Gen. Osmond J. Ritland remains as commander of BMD.

Ballistic Missile Division will have operational control of the missile static test site at Edwards AFB, Calif., and of the 6555th Test Wing at Patrick AFB, Fla. The division also directs activities of the 6594th Test Wing at Palo Alto, Calif.

Division Responsibilities

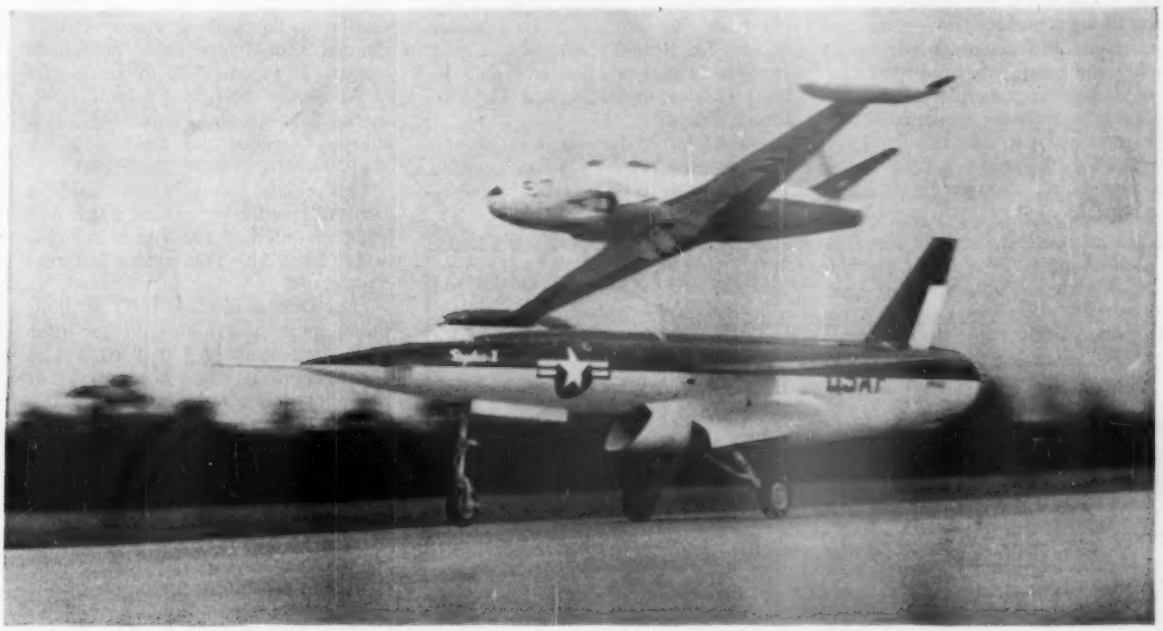
Wright Air Development Division was formed at Wright-Patterson AFB, Ohio, and will be responsible for developing a variety of weapon systems, including aircraft, aerodynamic missiles, missiles associated with aircraft, manned space systems and support systems.

The new division includes elements of the Wright Air Development Center and ARDC headquarters' Directorate of Systems Management, both of which are being discontinued. Only WADC laboratory not included in the new division is the Aeronautical Research Laboratory, at Wright-Patterson, which eventually will be assigned to the ARDC Research Division.

Directorate Setup

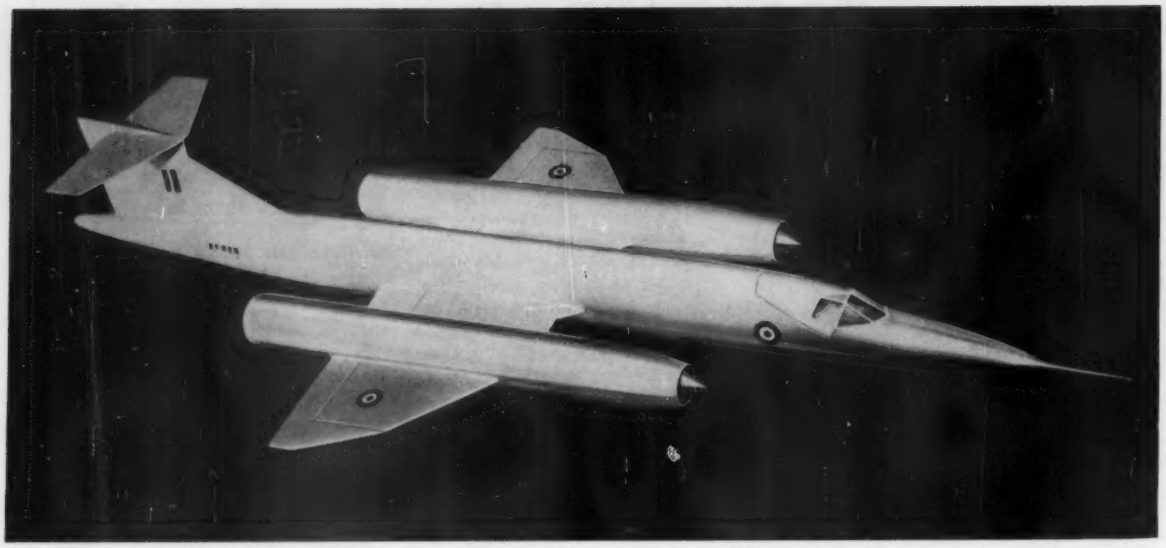
WADD is commanded by Maj. Gen. Stanley T. Wray, former WADC commander. Division includes a Directorate of Systems Management under Brig. Gen. Joseph R. Holzapple, a Directorate of Systems Engineering under Col. Fred J. Ascani and a Directorate of Advanced Systems Technology under Col. Albert L. Wallace, Jr. Vice commander of the division is Col. W. R. Grohs, chief scientist is John E. Keto.

Directorate of Systems Management will manage contractor work on weapon systems and will include the Weapon Systems Project Offices which operated under the old ARDC Directorate of Systems Management. Directorate of Systems Engineering will provide the engineering competence to direct contractors' technical efforts, and the Directorate of Advanced Systems Technology will plan future systems and work on the advanced technology leading to these future systems.



USAF Uses Regulus II As Bomarc Target Drone

Several Chance Vought Regulus II 1,000-mi.-range missiles originally developed for Navy are now being used by USAF as supersonic target drones for the Boeing Bomarc interceptor missile in firings from the Air Proving Ground Center, Eglin AFB, Fla. Three firings against the Bomarc have been attempted thus far. In the first, a near-miss was recorded. Second launch resulted in the destruction of the drone 200 mi. from the Bomarc launch site. Third attempt was aborted after a malfunction in the Regulus drone. In the picture above, a Lockheed T-33 is guiding a Regulus II to a landing at Eglin after an evaluation flight.



ARTIST'S conception of the Bristol T.188 stainless steel supersonic research aircraft is based on a model used for tests. Engineers claim the single-seat monoplane will be capable of speeds in excess of 1,500 mph. and will make its first flight next year.

Bristol T.188 May Be Ramjet Testbed

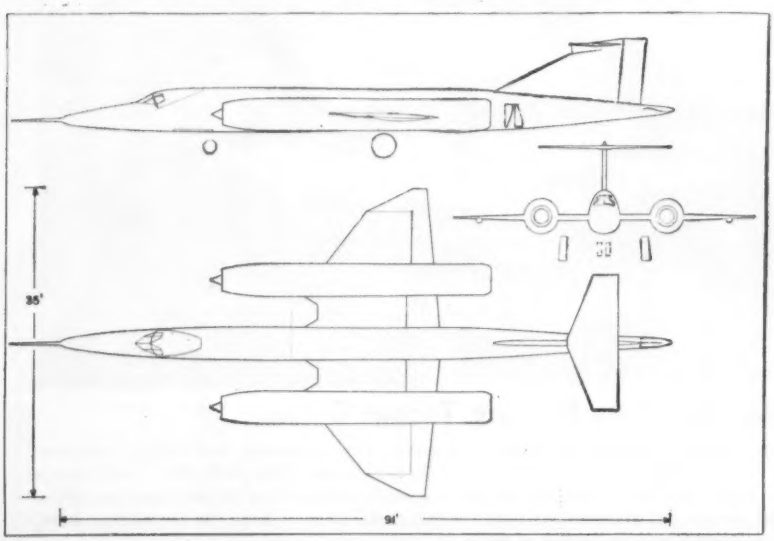
London—Bristol's T.188 stainless steel Mach 3 research aircraft (AW Dec. 14, p. 35), due to fly next autumn, may be used primarily as an engine testbed for ramjet and mixed ram-turbojet power plants now under development by Bristol Siddeley Engines, Ltd.

The research role will include investigation of flight and control systems and aerodynamic surfaces at speeds up to Mach 3 and possibly beyond the capacity of its present powerplants. At least two aircraft are under construction.

Features of its two de Havilland Gyron Jr. DGJ.10 engines include a variable geometry, convergent-divergent multi-petal nozzle, high-augmentation afterburner and a notably low frontal area for a thrust with afterburner of 14,000 lb. (AW Sept. 14, p. 68).

Partial declassification of the T.188 almost a year before its first flight possibly was influenced by political reasons aimed at publicizing the British effort in this field, and as a morale booster for Britain's struggling aircraft industry. Usual practice in Britain has been to wait until the first flight for formal release.

No military requirement for the aircraft now exists and the configuration, which appears to have been adopted between five or six years ago, bears no relation to any current projected British supersonic airliner.



THREE-VIEW drawing emphasizes long nacelles (about 30 ft. long) and high tailplane.

The aircraft has a 35 ft. span, thin, biconvex wing of 4% thickness-chord ratio and mounts engine nacelles near the center of each semispan. One advantage claimed for the wing engine nacelles is the ease of engine change afforded should alternative propulsion systems be investigated. A by-product of the engine location is some drag reduction due to shockwave interaction between nacelles and fuselage which create favorable intake conditions.

This engine position also made a high tail position obligatory, a slab unit being mounted at the top of a highly swept, fixed fin. The rudder has constant chord.

Oval section fuselage is 71 ft. long, shows some area ruling and has maximum dimensions of 3 ft. 9 in. x 4 ft. 11½ in. depth necessary to accommodate the pilot and ejection seat. Fuselage mounts the landing gear.

Wing details reveal leading edge sweep of 38 deg. over the center section of each semi-span, stepped to 64 deg. over an all-moving tip which functions as an aileron. Small leading edge extensions at nacelle and fuselage junctions improve the flow. Outboard blisters on the wing underside are believed to shroud aileron jacks.

Trailing edge flaps are fitted on the inner wing section and airbrakes are located at the rear of the fuselage. No other high lift aerodynamic devices are believed to have been incorporated. But the company claims that low speed handling characteristics are not inferior

to other supersonic aircraft and see no reason why the maiden flight should not take place at Filton. Wing area is 396 sq. ft. and the gross weight probably is about 40,000 lb.

Ceramics are not used structurally and play a minor role elsewhere. The aircraft is virtually an all-welded, stainless steel structure and is not thought to make significant use of sandwich construction.

Engine flight tests are due to start next month in a Gloster Javelin. Twenty models were used in a wind tunnel program to evaluate supersonic aerodynamic and stress characteristics. Free flight rocket-boosted models flown from the Royal Aircraft Establishment were used to investigate flutter characteristics, using high frequency telemetry techniques developed by the Bristol Guided Weapons Department.

USAF Invites Design Proposals For Nuclear Space Power System

Los Angeles—Air Force plans for nuclear-energy hardware related to upper-stage space powerplant requirements for interplanetary missions indicate that a feasible electric propulsion system may be developed within five-to-six years.

One of the critical developments for such a space powerplant—either ion or plasma—is lightweight electric power generating equipment. Anticipating problems in this area, Air Force's Wright Air Development Center is initiating an industry competition for the design study and development of a 300 kw. nuclear-mechanical power system for electrical propulsion engines. Timetable highlights are:

- **Requests for proposals** were distributed in November to selected industry members.
- **Industry briefing** was scheduled for last week at WADC.
- **Proposals on the nuclear-mechanical** power system are due from industry on Feb. 1.

Air Force anticipates that the program will involve five-to-six years of effort from the initiation of the study phase of the program and has advised industry of this time projection. Both Air Force and industry realize that the attainment of a 300-kw. capacity cannot be achieved by the relatively simple extrapolation used in boosting the 2 kw. SNAP 2 to the 30 kw. SNAP 8 nuclear turboelectric power generation systems (AW Dec. 7, p. 87) now under development.

Development Complication

Another complication to the development is that Air Force is specifying that the 300 kw. capability is to incorporate a growth potential to 1,000 kw. This initial power capacity for electric propulsion plus the required growth potential tags the program as a distinct state-of-the-art advancement over systems now under development.

Another requirement of the 300 kw. nuclear-mechanical power system is that it must have a closed cycle dynamic conversion scheme. Competitors also must specify the operating cycle, as part of their proposals.

Air Force is not promoting the entire study alone. First year's study will be financed by the Air Force only, but following years of the effort will involve participation of the Atomic Energy Commission as well.

Estimate is that about 20 industry members will submit proposals to WADC in the competition for the 300 kw. system. These probably will include:

- **North American Aviation's** Atomics International Division.
- **General Electric Co.**
- **Westinghouse Electric Co.**
- **The Martin Co.**
- **Aerojet-General Corp.**
- **Marquardt Aircraft Corp.**
- **General Dynamics Corp.'s** General Atomics Division.
- **Lockheed Aircraft Corp.'s** Georgia Division.
- **General Motors Corp.'s** Allison Division.
- **Curtiss-Wright Corp.**
- **Garrett Corp.'s** AirResearch Division.

Marines Order Missile Developed by Germans

Washington—Marine Corps has ordered 100 portable, lightweight anti-tank missiles developed by a West German firm. It will be evaluated beginning next month at Camp Pendleton, Calif.

The 20 lb. missile is wire-guided from a small control box. It carries a 3.3 lb. shaped warhead which reportedly can penetrate 21¼ in. of armor plate. Missile has a maximum range of nearly 2,000 yards, travels at a maximum velocity of 191 mph. and can be fired from the ground without the need for a special launching platform (AW June 29, p. 45).

New anti-tank missile bears the name of the Cobra, same name designation that has been applied to a new air-to-surface missile being developed by Naval Ordnance Test Station at Invokern, Calif., also for the Marine Corps, and intended to home on enemy radar stations.

The anti-tank Cobra was developed by Boelkow Entwicklungen K. G. of Munich for use by the West German Army. Daystrom, Inc., Murray Hill, N. J., has obtained exclusive rights for the sale and manufacture of the weapon in the U. S. The missile is expected to cost less than $1,000 in quantity production, according to Daystrom estimates.

The missile, measuring 30.7 in. in length and 3.9 in. in diameter, has cruciform wings which also serve as a launching platform. Missile takes off under power of an externally-carried solid-propellant booster whose thrust vector is angled down to provide a 22-deg. takeoff angle. After booster burnout, solid-propellant sustainer engine takes over.

Total burning time of the two engines is about 30 sec.

The anti-tank Cobra carries a string-wound gyroscope for stabilization. Missile guidance is provided by spoilers in each wing which are solenoid operated. Spoilers oscillate at about six and one-half cycles per second under no-command conditions, lock into one position or another when a steering command is received from the ground controller.

Guidance signals are transmitted over a thin two-conductor wire which is unreeled as the missile proceeds toward its target. Steering signals are introduced from a small 4.4 lb. control box with a miniature control stick which gives up-down, left-right signals that are transmitted by wire to the missile.

The missile and its detached warhead are carried in a lightweight packing case. Weapon can be assembled, set up and ready for launch in less than two minutes, Daystrom says. As many as eight Cobra missiles can be fired and guided from a single control station, but only a single missile can be guided at any one time. The warhead is armed automatically approximately three seconds after launch.

The Cobra, referred to also as Weapon System 810, includes a portable field simulator that can be used to train operators in guiding the weapon without firing actual missiles. It consists of a large cathode ray tube on which are displayed a target, whose size, position and movement are controlled by an instructor, and a small pip, representing the Cobra, which is guided by signals from the trainee's control station stick.

Compared with other anti-tank missiles now in use, Daystrom says the Cobra is lighter, less complex, less costly, has a warhead with greater penetration power and requires no launching platform.

French Stand Hampers NATO Posture

By Robert E. Farrell

Paris—Effectiveness of North Atlantic Treaty Organization military posture in Western Europe continues to hinge on an unsettled difference between France and the United States over how the NATO treaty should be operated.

This was the main conclusion drawn by military observers here as NATO held its annual ministerial meeting on the eve of the Paris Western summit conference. The problem continues to center on French refusal to accept integration of its European units under unified NATO command. Behind this French military policy looms the complex political aspirations of French President Charles de Gaulle to carve out more significant role for France in world affairs.

Military Portions

Military portions of the NATO ministerial meeting were sparked by an exchange between French and U. S. officials over recent criticism of the French attitude made by Gen. Nathan Twining. Twining, in a secret Paris talk before NATO's Military Committee a week earlier, singled out France as the major offender in NATO's sagging military posture.

Defense Secretary Thomas Gates, speaking at the NATO ministerial meeting, denied a French request that Twining's leaked remarks be repudiated. Gates told the meeting that the U. S. endorsed the "military substance" of Twining's criticism.

Despite the Franco-American clash, NATO members agreed to support a continuing military program which provides for a considerable buildup of atomic delivery capability among NATO forces in Western Europe. This program calls for some 100 rocket and missile battalions by 1963, instead of the present 30. Included in this missile inventory will be Martin Maces and Pershing tactical missiles, and perhaps also NATO development of the British Blue Water tactical missile (AW Dec. 14, p. 29).

Gates said that NATO-wide development of weapons such as the Hawk ground-to-air and Sidewinder air-to-air missiles, which European members are financing and building themselves, points to a new trend in NATO's armament program. Gates also cited NATO development of the French Breguet twin engine Alize anti-submarine warfare aircraft as a "successful project."

Both Gates and U. S. Secretary of State Christian Herter emphasized that the U. S. expected European NATO members to take on more of financial burden in keeping NATO's armament up-to-date. European reception to this idea, according to a U. S. source, was "warmly satisfying." Most U. S. officials, in fact, privately expressed their relief that—aside from France—every other NATO nation supported the U. S. delegation down the line.

If the NATO ministerial meeting failed to settle Franco-American differences over NATO, few military observers expect the Western summit conference to do any better. This is because Gen. de Gaulle is flatly opposed to NATO's principle of integration of forces at command levels wherever this means France would lose control over the deployment of its national forces. Thus, in certain NATO areas of responsibility, such as European air defense, France alone of the NATO nations has refused to integrate its air units.

This French attitude has been consistent over the years and actually predates Gen. de Gaulle's arrival to power. But NATO officials point out that Soviet advances in airpower over the years has made the question of European integrated air defense vitally important. NATO's early warning radar system, slated for completion late next year, is based on the principle of integrated NATO air defense.

Foot-Dragging

Actually, French foot-dragging within NATO ranks stems mainly from political aspirations rather than from military policy. De Gaulle, like his predecessors, feels that France—unlike Great Britain—hasn't received "Big Power" recognition from Washington.

De Gaulle wants to see Washington, London and Paris join together in a special group to direct alliance affairs, not only in Western Europe but in all areas of the world. Since this French concept was received coldly in every NATO capital, the French have set about their foot-dragging policy in earnest.

Actually, the French attitude toward NATO becomes more complicated by the fact that many French military officials appear to disagree with Gen. de Gaulle over the question of integration. French Gen. Jean Valluy, commander-in-chief, Allied Forces-Central Europe, recently declared that "French military policy of non-integration excludes the Central Europe Command." Yet another French general Raymond Brohon who holds subordinate tactical air command under Valluy, countered with a statement that no foreign officer which would include the Supreme Allied Commander, U. S. Gen. Lauris Norstad, had the right to give him orders to deploy his forces and open fire on an enemy.

USAF Sets Three New Records

Edwards AFB, Calif.—Air Force has established three new world records here by flying the F-104C to 103,395 ft., the F-106 at 1,525.9 mph. and the F-105B over a 100 km. closed course at 1,216.4 mph.

USAF altitude record exceeded by 4,835 ft. the 98,560 ft. record by the Navy just a week earlier with a McDonnell F4H (AW Dec. 14, p. 32). Navy had broken a 94,658 ft. record set by the Soviet Union last July.

World speed record set by the Convair F-106 exceeded the 1,484 mph. record claimed in October by the Soviet Union for the single-turbojet Sukhoi delta designated the E66. The Republic F-105B closed-course record topped the official mark of 1,100 mph. set last June by a French Dassault Mirage 3A.

Lockheed F-104C was flown by Capt. Joe B. Jordan. During the altitude run, the fighter also set a new 30,000 meter time-to-climb record by reaching that level (98,424 ft.) 15 min. 4.92 sec. from the time the flight began.

Maj. Joseph W. Rogers flew the F-106, a production model instrumented and configured at normal combat weight. Starting the speed run at 40,000 ft., the fighter flew the 18 km. course twice averaging 1,525.9 mph.

Flying an F-105B from the 334th Tactical Fighter Squadron at Seymour-Johnson AFB, N. C., Brig. Gen. Joseph H. Moore covered the circular 100 km. course in 183 sec. Flight was made at 38,000 ft., and the pilot was under 2.5g during the run. Course was laid out in a circle with a 9.9 mi. diameter. F-105B was an operational version and weighed 40,425 lb. at takeoff, including 2,000 gal. of fuel.

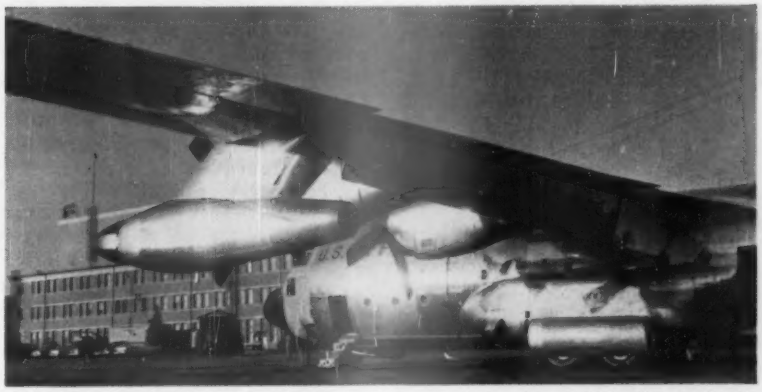
Flights were supervised by National Aeronautics Assn., and films and other supporting data have been submitted to the Federation Aeronautique Internationale for certification of the records.

Pilots of the three aircraft were awarded trophies for their record efforts. Thompson Trophy went to Maj. Rogers for the speed record, special Bendix award went to Gen. Moore for the closed-course record and the General Electric Trophy was awarded to Capt. Jordan for the record altitude flight.

Lockheed NC-130B Hercules, fitted with two boundary layer control engines, is readied for its first flight at Lockheed Aircraft's Marietta, Ga., facility. Plane is powered by four Allison T56 turboprop engines and has short field takeoff and landing capability.

C-130B Modified for Boundary Layer Control

Advanced version of the Lockheed C-130B, the NC-130B, has been fitted as a testbed for two load compressor engines which will provide boundary layer control for short takeoff and land characteristics. Engines are two YT56-A-6s which pump a steady jet of compressed air over control surfaces; clamshell doors are open for landings and takeoff and closed for cruise. Large flaps extend to 90-deg.-down position. Lockheed engineers claim the airplane will be airborne in 460 ft. and will land in a similar distance. NC-130B's four Allison T56 turboprop engines, fitted with Hamilton Standard propellers, produce 4,050 eshp. each. Gross weight is 135,000 lb. Severe full-flap angle will be standard short takeoff and land configuration for the troop-cargo carrier.



C-130B flaps can be lowered to full 90 deg. down angle for short field landings, takeoffs.

Side view shows load compressor engine with clamshell doors open for takeoff; engine provides boundary layer control for flaps, ailerons, elevators and rudder. Testbed is an advanced version of the C-130B and will make its first flight this month.

Johnson Criticizes Administration For Delays in U.S. Space Effort

Washington—Lack of leadership and failure of the Administration to grasp the significance of space exploration are the reasons the U.S. continues to lag behind the Russians in this field, Sen. Lyndon Johnson (D.-Tex.) charged last week.

Sen. Johnson was highly critical of the progress made under the national space program and called for immediate action and maximum effort in an attempt to catch up. "We can no longer afford procrastination and endless delay," he said at the annual Wright Memorial Dinner, nor, he added, can the U.S. "indulge in the luxury of budget clerks gambling with our destiny."

"Our program for space is part of our over-all national defense needs," Johnson said. "Let us devote the necessary resources to our technical frontier so that we can continually build up strength. The survival of our nation and the rest of the free world could well be at stake. This is not a partisan matter, it is a national problem."

Sen. Johnson added that peace cannot be achieved through military weakness and that the principle of strength is equally applicable to the space program. Therefore, he said, the following action must be taken immediately:

- **"We must decide at the highest** national level that we are going to compete—and win.
- **"We must set forth clearly** our basic objectives in space.
- **"We must establish firm management** leadership over the programs necessary to meet these objectives, and we must back up our leaders with clear-cut authority and responsibilities.
- **"We must provide the essential** funds and priorities necessary to accomplish the objectives.
- **"We must eliminate arbitrary fund** limitations and authorize whatever overtime may be necessary to get big boosters as soon as it is practicable.
- **"We must establish a comprehensive** national space program as called for in the Space Act, lest we continue down the road without a road map.
- **"We must provide for truly effective** coordination of the military and civilian elements of the space program."

Sen. Johnson, chairman of the Senate Space Committee, pointed to the delay in the Saturn 1.5 million-lb.-thrust rocket as indicative of what the U.S. is doing in space. He said work on the project was not started until seven months after it was recommended by Congress and that there was to have been a static firing of the engine this month, but that according to his latest information it will be delayed until at least spring of next year (see box).

"The dismal story of drift, delay and dilution in the Saturn program is not yet over," he charged. "While next year's budget requests on this project have not been officially submitted, those directly responsible for the Saturn program have already made it clear that the program will need at least $100 million more than the Administration proposes to request.

"To me, this is deeply disturbing," he said. "Clearly, the impression that we must win the race for space has not penetrated certain Washington levels.

"The whole field of space needs one head—one man to be accountable, one man with the powers to accomplish. We thought we had done this in the Space Act when we put the President in charge of it. If the Executive Department cannot or will not meet this responsibility, then the Congress must act," Sen. Johnson said. "America cannot sit out 1960 and wait to start up again, somewhere down the road."

Saturn Booster Bids

Washington—Saturn second stage development apparently will await a 150,000 lb. liquid hydrogen-fueled engine. Competition for the engine is expected to begin next March. Several companies were to present informal proposals for third and fourth stages to the National Aeronautics and Space Administration-Advanced Research Projects Agency technical committee last week. Second stage could use two 150,000 lb. hydrogen engines but probably would use four. Upper stages also may use hydrogen fuel.

X-15 Flight Aborted After Regulator Fails

Edwards AFB, Calif.—First powered flight of North American X-15 aircraft No. 1 was aborted here last week 10 sec. before the scheduled drop from a Boeing B-52 mother ship at an altitude of about 45,000 ft.

Flight was called off when the liquid oxygen regulator in the X-15 failed to pressurize properly. Radio reception also was defective in that pilot Scott Crossfield was able to receive but not to transmit. The radio failure would not have warranted canceling the drop if the liquid oxygen regulator trouble had not developed. Crossfield gave the "don't launch" sign to the mother ship with his hand. The powered flight in the X-15 aircraft No. 1 was scheduled to be the first in a short series before this aircraft was to be turned over to National Aeronautics and Space Administration personnel at the Edwards facility.

News Digest

Thor-Able IV space probe launching was postponed last week due to electronic problems in the payload. The National Aeronautics and Space Administration probe is intended to explore space between the orbits of earth and Venus and to test communications over distances of 50 million mi. or more (AW Dec. 14, p. 34).

Beech Aircraft Fiscal 1959 net income was $3,968,280—19.4% more than 1958 net earnings of $3,324,663. Total sales in 1959 were $89,536,620, compared with $95,889,733 in Fiscal 1958. Per share earnings for 1959 were $4.74 compared with $4.03 in Fiscal 1958.

Maj. Gen. Ben I. Funk, commander of Air Materiel Command Ballistic Missiles Center, will replace retiring Maj. Gen. John S. Mills as commander of San Bernardino Air Materiel Area. Brig. Gen. Don Coupland, deputy commander of San Bernardino AMA, will replace Funk as BMC commander.

Doman Helicopters, Inc., stockholders approved a reorganization plan last week which calls for a reverse one-for-10 common stock split, issuance to creditors of 2% five-year convertible debentures on a dollar-for-dollar basis and issuance of 75,000 shares of 6% preferred stock of $10 par value (AW Sept. 28, p. 100). Common stockholders would have the right to buy the new preferred stock, each share of which would be convertible into 10 new common shares of 10 cents par value. Present common has $1 par value. Plan is subject to SEC approval. Under the proposal, a group headed by N. Clarkson Earl, Jr., Doman board chairman, will invest a minimum of $300,000 in the company.

Chance Vought Aircraft's Aeronautics Division has been awarded a $58 million contract by U.S. Navy for follow-on production of the F8U-2N jet fighter.

Rolls-Royce RB.141 turbojet bypass engine (AW Sept. 28, p. 54) has completed its first test run and exceeded the design thrust rating 15,000 lb. against a 14,300 lb. design figure. Special mixing arrangement enables the hot-core gases to mix with the cooler bypass air.

Copilot Rules Will Be Bargaining Issue

ALPA dissatisfied with FAA training regulation; will settle the question directly with airlines.

By Robert H. Cook

Washington—Dissatisfaction with the scope of Federal Aviation Agency's new airline copilot training regulations is leading Air Line Pilots Assn. to shift its campaign and make the copilot question a major bargaining issue in 1960 contract negotiations.

ALPA reaction to the copilot regulations finally adopted was a mixture of surprise and disappointment, since ALPA has urged tighter initial qualifications and training for copilot members since 1956, and the union played a major role in formulating FAA's originally proposed rule change.

Terming the adopted regulations (AW Dec. 7, p. 45) a "watered down" version of those originally proposed by the agency, the union also said they represent an "ineffectual compromise" with FAA's own proposals for increased flight safety and an indication that the agency "evidently decided to bow to the air carriers' objections to adequate rules based largely on cost." Objections of the airlines had centered around contentions that imposition of the training requirements originally proposed would prove too costly and would be unnecessary.

When the regulation was issued, FAA noted that it originally favored requiring two flight proficiency checks a year plus type rating for each aircraft on which the copilot served. "Upon re-evaluation" and "in the light of comments received," the agency said the objectives sought in the more extensive original draft could be attained by requiring an expansion of initial flight training maneuvers and procedures for copilots in addition to an annual proficiency check given by an FAA or company-designated flight inspector.

Delta Contract

ALPA officials now feel the problem must be settled on an individual airline basis, and they cite as an example Delta Air Lines' current pilot contract which provides copilots with much the same training as pilots in Douglas DC-8 jet transition, including a type rating on the aircraft and an airline transport pilot rating for the second in command.

A full year remains before the airlines must comply with the new regulation, and ALPA said this period gives labor and management a full opportunity to discuss the issue before the rule is put into practice.

Current contracts with Eastern Air Lines and Trans World Airlines expire near the end of 1960, and several more contracts expire in the spring of the following year.

On the basis of questionnaires mailed to a number of copilot members, the union said criticism of airline training programs continues to grow, while the new FAA regulation is regarded as completely inadequate.

Union spokesmen said, however, that ALPA members claim the problem is concerned primarily with older flight equipment and not with new jet aircraft being phased into airline fleets under manufacturers' recommended training procedures. Even here, ALPA contends, a problem exists where airlines sometimes follow a rigid training program for the first few operational crews, then cut back training times as more aircraft are acquired.

United Air Lines is one of the few carriers where ALPA members feel their training is adequate to carry out the union's "fail safe" concept of crew duties, where one crew member is qualified to relieve another. The carrier exceeds training requirements established by FAA, provides copilots with an air transport pilot rating after three years' training and requires a copilot proficiency check every six months as compared with once a year under new FAA regulations. Ground and flight training are both conducted with the crew of pilot, copilot and flight engineer as a unit, instead of on an individual basis.

What ALPA Wants

Copilot training and qualification requested by ALPA included:

• **Change of current** qualifications calling only for a commercial license and instrument rating to a new airline transport license for copilots requiring at least 1,000 hr. of dual and solo flight on an aircraft of less than 12,500 lb. or 750 hr. on larger aircraft.

• **Type rating for each aircraft** on which the copilot may be assigned, to assure that he is fully qualified to handle the plane and relieve the pilot in event of emergency.

• **Proficiency check,** same as the check given a pilot, every six months.

In its proposed regulation change, FAA boiled the request down to requiring type ratings for each aircraft and the two proficiency checks, as suggested by ALPA.

Following a study of comments on the proposal, the agency adopted the new regulation. It eliminates the type rating provision and requires only one annual proficiency check, but it puts heavy emphasis on expanding initial flight training to include such maneuvers as taxiing, takeoffs and landings, climbs and turns, slow flight, approach to stall, takeoff and landing with simulated engine failure plus simulated instrument conditions and many other emergency procedures not formerly required.

FAA feels it has taken a justifiable course in adopting the new regulations, which spokesmen call a "far cry" from the initial training formerly provided. Proficiency checks will be given by an FAA inspector, or designated agent, with every other check given in the largest aircraft involved where the copilot serves in more than one plane. In addition, the proficiency check must include both a written and oral examination.

Three-Pilot Rule

In the case of aircraft with a three-pilot crew, such as those on long international flights, the new rules also require the pilot second in command to meet the same initial training as the pilot in command, and to take an annual proficiency check. Airline training programs also will be subject to FAA approval and monitoring, with the carriers expected to submit their programs for approval by July, 1960.

ALPA feels that FAA has "missed the point" in adopting such regulations and claims the main purpose of its campaign—assuring that the copilot can safely handle the aircraft if the pilot in command becomes ill—has been ignored.

In a like manner, the union says FAA ideas on approving airline training programs have little value since the agency has not indicated just what the programs should include or how they may be monitored to ensure airline compliance.

Northwest Requests Injunction In Engineer Training Dispute

Washington – Refusal of several Northwest Airlines flight engineers to fly the company's new Lockheed Electra turboprop transports on grounds of insufficient training resulted last week in the company seeking a federal court order to prevent any intervention in the dispute by the International Assn. of Machinists on behalf of its flight engineer members.

A temporary restraining order issued against the IAM by a federal court in Minneapolis was scheduled for a hearing late last week before Judge Edward J. Devitt on Northwest's request for an injunction against the union. The company claims that the union influenced nine flight engineers to reject Electra assignments because of the airline's three week transition training program.

Union spokesmen have denied that they influenced their members in any way and say that the decision to accept or reject Electra assignments was a voluntary choice on the part of the individuals concerned.

Crux of the current dispute, the union says, is that the airline has cut its Electra transitional training for engineers from an eight week to a three week course. IAM also blames pilot demands for the same engineering training for the cut and say that, once it was granted, Northwest decreased the instruction time at the request of their pilots who said it was too lengthy. Nineteen other flight engineers, who received an eight week course, have had no problem and are on active duty, the union said.

When nine flight engineers refused an Electra assignment because they considered three weeks an insufficient transition time, Northwest furloughed a total of 13 engineers and then instituted its legal action.

Northwest contends that any disagreement over flight assignments should properly be handled through grievance and arbitration procedures set forth in contracts between the airline and IAM. Refusal of the flight engineers to follow such a procedure, the company said, resulted in a complete shutdown of the Electra training program for a short period and the furloughing of 13 flight engineers and 12 copilots. Two of the nine engineers who refused Electra assignments have since returned to duty and are now flying, according to the company. Faced with this situation, Northwest said it "reluctantly" took the matter to the federal court.

Airline engineer training programs also came under fire last week from the Flight Engineers International Assn., which criticized the length of the instruction, varying from three to eight weeks. FEIA officials pointed out that several foreign carriers such as British Overseas Airways Corp. and Scandinavian Airways System, both provide a 12-week jet transition course for flight engineers.

Ron Brown, FEIA president, also attacked the Air Line Pilots Assn. as being responsible for a portion of the reduced training times, through its demands for "equal time" engineering training.

At the same time, Brown noted that, while ALPA has objected to new Federal Aviation Agency rules on copilot training as insufficient (see p. 27), the pilots are "actively trying to reduce the training of the only technical specialist on board the aircraft . . . the flight engineer."

Sabena Orders Four Faster Caravelles

Paris—Sabena Belgian World Airlines has ordered four Sud Caravelle jet transports fitted with improved Rolls-Royce Ra. 29 turbojets which provide an extra 46 kt. airspeed and increased range. Airline also took an option on four more Caravelles.

New Ra. 29, designated Mk. 6, produces 12,500-lb. thrust, an increase of 2,000 lb. over Ra. 29s used in Caravelles now in service. Speed will be 450 kt., against the present 404 kt. and range will be boosted to about 1,500 mi., compared with the current 1,000 mi. range. The plane will carry the same payload.

Rolls-Royce currently is developing a still more advanced Ra. 29 engine which will produce 11,700 lb. thrust.

First deliveries will be made to Sabena next February. The order brings to 59 the total number of firm orders placed for Caravelles with Sud Aviation; options total 23.

Britain Approves BOAC Fare Cuts

London – British Overseas Airways Corp. has received government approval to cut fares on its routes to British territories overseas. Independent airlines, which also have been campaigning for permission to slash fares on similar routes, have not yet received the go-ahead.

Announcing approval in Parliament this week, Aviation Minister Duncan Sandys said the exact level of new fares and timing of their introduction was still undecided but cuts would vary between 10 and 20% of existing fares. He said he was consulting with colonial authorities and other airlines involved before making the fare reduction move final.

Earlier this year, British independent operators asked the government for permission to cut fares to colonial territories abroad by as much as 50%. BOAC said it would oppose the proposals. Shortly after, the state-controlled airline said it was seeking government approval to introduce economy class fares on its cabotage air routes to the West Indies, Far East and Africa (AW Oct. 19, p. 38).

Although the government hasn't yet made a decision on the independents' application, Sandys said he was "taking steps to ensure that the reduction in BOAC fares shall not unfairly affect colonial coach routes which these independent companies have so successfully opened up." He pointed out that the "very low" fares independents had proposed were distinct from economy fares. He said he was working closely with the independent operators and state airlines to work out a solution to the problem.

Sandys referred to Britain's warning to International Air Transport Assn. that if an agreement wasn't reached on economy air fares generally, it would consider introducing them independently on cabotage routes between Britain and its overseas territories.

BOAC and British European Airways would be facing "formidable" problems in the near future, the minister said. Most of the new aircraft coming into service would carry about 50% more passengers. To make economic use of this increased passenger carrying power, a large increase in air traffic was "absolutely essential," Sandy's said, adding "I am convinced the only way to do that is by boldly cutting down fares."

American Shippers Inc.

AVIATION WEEK article appearing in the Nov. 23 issue (p. 52) reporting a Civil Aeronautics Board order affecting American Shippers, Inc., was incorrectly headed "American Shippers, Inc. Lose Operating Rights."

The organization's operating authority has not been revoked. The Board issued a technical cease and desist order against the company following the firm's conviction by a civil court which levied a fine for 15 separate violations of sections of the Federal Aviation and Uniform Bill of Lading Acts. AVIATION WEEK regrets the error.

Sectional Overhaul Approved for CJ-805

By L. L. Doty

Washington—Federal Aviation Agency today approved a "sectionalized" engine overhaul system for the General Electric CJ-805-3 turbojet engine that sets a 1,600 hr. overhaul time for compressors and 900 hr. for the combustion and turbine areas of the engines.

The FAA approval, which marked the first time the agency has approved such an overhaul system, will enable both Trans World Airlines and Delta Air Lines to adopt the new method of divided overhaul on the engines which will power the Convair 880 transport on order by the two airlines for delivery in 1960. For overhaul purposes, the 1,600 hr. time between overhaul periods will cover the cold section of the engine or all parts forward of the rear compressor frame. The hot section, set for 900 hr. time between overhaul, is defined as all areas of the engine aft of the fire wall.

In commenting on the sectionalized program, R. B. Smith, manager of GE's CJ-805 service group, said, "we estimate that overhaul material and labor costs per engine hour will be approximately 20% less for engines overhauled at the 1,600/900 hr. rate than for engines overhauled at the conventional 1,000 hr. rate for all engine sections."

Airlines which adopt the split overhaul system on the CJ-805-3 engines will be required initially to undertake a series of four engine samplings prior to introducing the actual 1,600/900 overhaul time. In the first sampling, hot section time will be established at 800 hr. The cold section time will also be set at 800 hr.

At each progressive sampling, cold section time will be hiked upward 200 hr. until the 1,600 hr. level is reached. Hot section overhaul time will remain at 800 hr. up to the fourth and final sampling when the time between overhaul period will be boosted to the FAA approved 900 hr.

To support its application for the 1,600/900 hr. sectionalized system, General Electric conducted a dual testing program with seven of the turbojet engines. First phase of the program embraced factory endurance ground tests at Evendale, Ohio. Second phase covered a series of flight endurance tests at Edwards AFB, Calif., using a leased Air Force B-66A and a Navy XF4D as testbeds for the engines (AW Apr. 13, p. 149).

The B-66 was equipped with modified pods, simulating the features of the Convair 880 nacelle, to house the CJ-805 engines. During the flight tests, both engines were powered with West Coast commercial grade kerosene purposely selected to provide the poorest quality fuel possible.

In the factory endurance test program, one engine completed four 1,000 hr. tests and a second completed two 1,000 hr. factory endurance tests after which it was installed on the B-66 for a 1,000 hr. flight endurance test.

A third engine was used for performance evaluation of new CJ-805 engine components and another was used for turbine bucket stress tests. One engine is presently running on a factory 1,000 hr. simulated airline schedule and the other two were used for official FAA engine and component qualification testing and the official 150 hr. FAA certification test. The CJ-805 engine was certificated in September, 1958.

Teardown Findings

Here are a few samples of factory endurance teardown findings together with corrective action taken:

- **Cracks and leaks** were found in the lube oil tank in the second and third 1,000 hr. tests which called for a major redesign of the unit.
- **Ignition plug insulation** was redesigned when electrode erosion, internal arcing, gas leakage and failure to fire were experienced in the main ignition plug during the tests.
- **Worn piston valve and valve** housing of the tank pressure valve was discovered and the hardness of the valve face was changed to prevent wear and sticking.
- **Fuel leak into air passage** on the fuel heater was corrected by redesigning the unit to increase wall thickness of tubes and support members.

Purpose of the flight testing of the CJ-805 was to accumulate 1,000 hr. of flight time under performance conditions which would closely simulate airline operations. One engine installed on the B-66 for the tests had undergone two 1,000 hr. factory endurance tests. The second engine on the B-66 and the engine installed in the XF4D each had accumulated 300 hr. of flight testing prior to being retrofitted to the two aircraft.

The engine which had undergone the factory endurance tests completed 1,000 hr. of flight testing in the B-66 testbed in 86 days to reach an average daily utilization of 11.8 hr. The B-66 flight duration ran as high as five and one-half hour daily and daily utilization on the aircraft often exceeded 15 hr.

Total fuel consumed during the flight testing was 1.2 million gal. and oil consumption on the B-66 engines averaged .026 gal. per engine hour. No oil changes were made.

Operationally, the B-66 completed one nonstop flight from Los Angeles to Washington in 3 hr. 35 min. for an average speed of 630 mph. A second nonstop flight from Washington to Los Angeles was completed in 4 hr. 58 min.

In February, the B-66 was flown at Duluth for two weeks for cold weather tests where it operated in ambient temperatures as low as −27F. A total of 97 air starts were made during the tests at all altitudes up to 42,000 ft. without one failure to start.

Teardown findings at the conclusion of the 1,000 hr. flight test program indicated only minor discrepancies such as nicks, burrs and boss gusset cracks in the compressor casings. A small number of stator vanes and compressor blades would require replacement due to dents or nicks resulting from foreign object ingestion.

Generally, however, GE engineers found the compression section in excellent condition. More discrepencies were found in the engine which had undergone the factory endurance tests—due, probably, to the higher total time accumulated on this engine as compared with the airborne engine.

Five compressor blades in the more highly used engine will be replaced because of minor magnaflux and forging lap indications not critical in nature. Compressor rotors in both engines were in "very good condition," according to GE engineers.

Minor cracking, which had been anticipated, was found in combustion liners. Under existing overhaul limits, only one of the 20 combustion liners from the two engines will be replaced—the balance are repairable.

Turbine stator assemblies in both engines were generally in good condition—each showing minor casing cracks in welds which will be repaired. Both turbine nozzles had cracks in partitions and inner and outer bands which will be repaired by welding.

Honeycomb shrouds were in satisfactory condition with only one segment in need of repair. Turbine frames in both engines had several strut weld cracks at both inner and outer ends.

Bearing wear was found to be almost imperceptible. The newer engine experienced a failure of a tab washer on a bevel gear bolt in the transfer gear case. Pieces of the tab washer caused failure of the transfer gear case sump pump. Before going into airline service, tab washers are being removed from all engines and replaced with a longer bolt that is peened after assembly.

New Jersey Airport Plan Faces Hurdles

By Glenn Garrison

New York—Port of New York Authority's proposal for a $220-million jet airport in Morris County, N. J., faces thorny political and economic hurdles before it can become a reality.

The 10,000-acre, four-runway proposed airport would be located, the Port Authority said last week, on the only suitable site among 15 evaluated in the New York-New Jersey metropolitan area during studies which began in 1957. With expected new highway construction, the airport would be 15.5 mi. from the Lincoln Tunnel into Manhattan and travel time would be 30 min. The site meets airspace requirements in that it allows a buffer zone of sufficient dimensions between it and other airports, and avoids conflict with traffic along north-south airways. Noise protection can be given communities by separating them by at least five miles from the start of takeoff roll, this being possible because the amount of land in the Great Swamp area involved would permit an airport large enough to provide these buffer spaces. The swampy site could be filled, the Port Authority said, less expensively than the site of New York International Airport was.

Future Need

Need for this fourth commercial airport, the Port Authority said, will become acute by 1965, when the capacity of La Guardia, New York International and Newark airports will be insufficient to handle an estimated doubling of traffic over last year's regional total of 13,451,000 passengers and 167,917 tons of cargo. By 1975, according to the Port Authority's forecasts, the passenger total will have reached 45,300,000 for the year. The New Jersey location, the Port Authority said, also is desirable because of predicted population growth in the region west of the Hudson River, expected to greatly exceed the increase on the east side of the river.

Present capacity of the three existing airports was set at 150 peak hour IFR movements, and the agency's studies indicated a peak area requirement of 169 movements in 1965 and more than 200 movements in 1975.

Earliest realistic target date for operation of the proposed airport, Port Authority Executive Director Austin Tobin said last week, is 1970.

Specific details of the plan are still tentative, and "further definitive studies" will not be completed for about six months, Tobin said. The Port Authority had planned to announce the project early in 1960, he said, but recent "leaks" concerning the plan had led to the earlier presentation.

The proposal was officially presented to the airlines for the first time last Monday morning at a breakfast meeting with Tobin and other Port Authority officials. Tobin told AVIATION WEEK that consultations with the carriers had been planned under the original public announcement schedule, but the "leaks" had prevented this.

Airline reaction for the record was that considerable study of the proposal was needed before comment could be made. Tobin told AVIATION WEEK that there had been no official reaction to the presentation at the high-level breakfast meeting, but that he imagined the airlines were wondering how they could financially support such a facility. "But the traffic figures speak for themselves," he added.

Federal Aviation Agency Regional Administrator Joseph Blatt called the airport plan an "effective proposal" and supported the Port Authority estimates of traffic and airport capacities. FAA has worked with the Port Authority on the study. Blatt told AVIATION WEEK that his agency made an independent study of the regional airport system several years ago and picked the same site as best suited to location of an additional airport.

The FAA study was in connection with design of airway patterns along the East Coast.

The Great Swamp location, Blatt said, is so obvious "it's almost a textbook solution" to the New York metropolitan problem.

The Port Authority report based its airport capacity calculations on 40 movements for a single instrument runway, as at La Guardia and Newark, and 70 movements for dual instrument strips, as planned by next month at Idlewild. Future demand would make the capacity inadequate by 1965 and "impossible" by 1975, according to the report, "even if technological improvements should result in some increase in capacity."

FAA feels that the 150-movement capacity estimate represents the best potential for the foreseeable future, even if new radar, automation or other traffic control instruments produced a theoretically greater potential. The three existing airports, Blatt said, set up a certain degree of mutual traffic pattern interference even though the 4-22 instrument strips of each are parallel. Thus great increases in volume are not possible in the area even if the technological advances made them possible elsewhere.

Anti-noise procedures in effect at all three airports also would restrict air traffic control in attaining its maximum efficiency. The new airport, Tobin said, would include built-in noise protection because of the extra land acquired as a buffer, which would total 4,400 acres in itself.

The Morris County airport would be provided with four 12,000-ft. runways, including two parallel instrument strips and two parallel runways at right angles to the instrument strips. This length, according to the Port Authority study, is the minimum required for long-haul domestic flights.

The new airport's role in the regional traffic picture, according to the report, would be to handle long, medium and short haul domestic flights and a few corporate and private aircraft. Idlewild would handle all international flights in addition to the above, and La Guardia would handle short-haul domestic and corporate and private flights. Teterboro Airport in New Jersey, the Port Authority's fourth airport now in the region, would continue to handle training, corporate and private traffic.

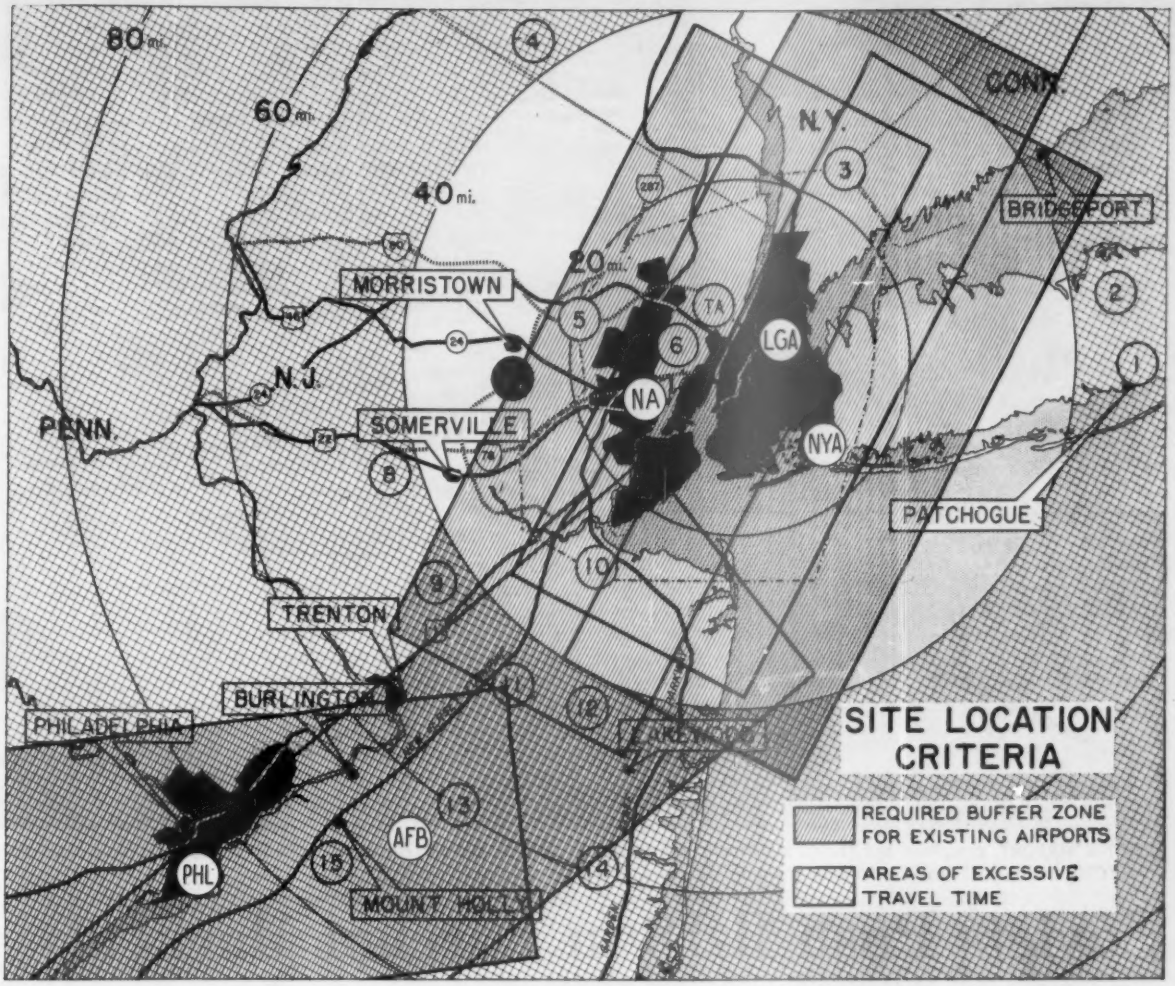
Supersonic Operations

But Tobin said last week that it was not "out of the question" to handle transatlantic traffic at the new airport. The Port Authority, AVIATION WEEK has learned, considers the proposed Morris County airport suitable for supersonic transport operations on the basis of presently predicted characteristics of such aircraft.

Supersonic transports will maintain subsonic flight until away from populated areas, according to present Port Authority thinking, and will not require longer runways than will subsonic jets. Thus sonic boom, potential source of major ground problems with supersonic operation, would not hit areas near an airport.

Other possible technological advances in aircraft such as STOL or VTOL types which might be used in city center to city center travel did not figure in the Port Authority's plan. According to Thomas Sullivan, deputy director of aviation for the agency, the Port Authority doesn't see these types of aircraft in the commercial picture in the near future. Blatt of FAA agreed that there was nothing of this kind on the horizon, even in the drafting board stage, that would be a commercial factor by the time the airport saturation had been reached.

The Port Authority's estimates of several years ago as to the effect of helicopter traffic on the handling of regional traffic have been scaled downward, and the report finds that the helicopter in



AIRPORT proposed by Port of New York Authority to relieve predicted saturation of existing fields by 1965 would be located in Morris County, N. J. Earliest probable completion would be 1970. Charts shows traffic control buffer zones around existing airports, each 32 x 80 mi. Center of new airport, Port Authority says, must lie outside these rectangles. Numbers represent the 15 sites evaluated for proposed airport, with No. 7 the Port Authority's chosen location.

the foreseeable future "will remain only a supplementary means of downtown-to-airport transportation." The airport site location, the Port Authority said, had to be chosen in terms of ground transportation and not "as might be supposed in this, the air age, on the basis of helicopter travel. The tremendous potential of the helicopter as a means of local air transportation has given rise to a popular belief that a major airport can be located 75 or even 100 mi. from the center of the area it is to serve. . . . Unfortunately, this is not a practical assumption."

Port Authority statistics show that 40% of the passengers using the New York and New Jersey airports get to and from the fields by private car, 31% by taxicab, 27% by airport coach, and 2% by other transportation including public buses and helicopters.

However, the report does foresee a greater future role for the helicopter in this service and notes that the Port Authority "has always had great faith in the future of the helicopter."

Political hurdles faced by the Port Authority in furthering its plan included necessary basic legislation to extend its area of operation in the New Jersey-New York port area. Action by the legislatures and approval by the governors of both states is necessary and Tobin said last week that he would not even try to get legislative approval until 1961.

Another problem is local community and political resistance, based in part on fear of aircraft noise and safety problems.

Among the problems of airline economics involved in the plan are split operation among four airports, financing new ground facilities, and ultimately paying for the entire project through rentals, landing fees and other means.

Napier Buys Convairs From United Air Lines

Washington—Napier Engines, Inc., has purchased a fleet of nine Convair 340s from United Air Lines for conversion to Napier turboprop power.

The manufacturer has no contracts to resell the aircraft but wants to establish a reserve fleet that will permit immediate delivery once a contract with a carrier is signed. United will deliver the aircraft to Napier by the end of January.

Meanwhile, Allegheny Airlines has leased from Napier a second Convair 340 converted to Napier turboprops for immediate use on its routes. Delivery of the 11 aircraft which Allegheny has purchased from Lockheed Aircraft Corp., and which do not include the nine Convairs purchased by Napier from United, will begin next spring.

PEKING AIRPORT, completed last March, can handle both turboprop and turbojet aircraft; note Tu-104 jet transport in foreground, with two Il-14s and an Li-2 near the terminal building. On hard stands in background are An-2s, Li-2s, Il-14s.

Soviets Push Il-18 in Foreign Markets

Washington—Soviet Union, satisfied that the Il-18 turboprop—the Moscow—meets all of Aeroflot's operational standards, is now pushing the aircraft in foreign markets and pressing it into scheduled service on international routes.

Aeroflot, Russia's state-owned airline, is now operating more than 50 Il-18s, and the aircraft is serving four major routes within the Soviet Union with daily schedules. After pursuing its adopted practice of running a new aircraft through drawn-out operational shakedown programs before placing them in scheduled service (AW July 6, p. 34), Aeroflot is now operating the Il-18 on routes and special flights that openly display the airplane's performance capabilities to the Western world.

Latest entry into Western Hemisphere markets was a special flight to Mexico City last month with refueling stops at Keflavik and Halifax. The flight was operated to carry A. I. Mikoyan, first deputy chairman of the USSR Council of Ministers, on a "goodwill" mission to Mexico.

The Russians, however, took full advantage of the flight, placed the aircraft on public display at the Mexico City airport and conducted special demonstration flights for top Mexican aviation officials. Military attaches from Argentina, Brazil, Uruguay and other Latin American countries also were invited to inspect the Il-18.

During the visit of Soviet Premier Nikita Khrushchev to Washington in September (AW Sept. 28, p. 45), the Il-18, Tu-114 turboprop and the Tu-104 turbojet, all of which carried the Khrushchev party here, were not opened to the general public although approximately 200 aviation and government officials were allowed to inspect the three airplanes during a six-hour period one Sunday.

On the Mexican trip, original plans called for Mikoyan and his party to fly the Moscow-Mexico City route nonstop in an intercontinental version of the Tu-114 turboprop transport. But "because the Mexico City airport was unable to receive a plane of such great weight," according to the Soviets, the smaller Il-18 was used.

Aeroflot's Deputy Chief for Operations V. F. Bashkirov, who was in charge of the Mexican flight, discussed the possibility of establishing commercial air ties between Russia and Mexico with members of the Mexican Ministry of Communications.

Earlier this year, the Russians sent the aircraft to Iraq as a prestige and promotional device in the Middle East. The plane flew the Moscow-Baghdad route nonstop in five and one-half hours over an indirect routing which covered more than 2,000 mi.

First scheduled operation of the Il-18 on air routes outside the Soviet bloc is on the London-Moscow route where it has replaced the Tu-104 twin turbojet-powered transport. British European Airways will reverse the Russian switch from turbojets to turboprops on the route by replacing its Vickers Viscounts with Comet 4Bs on the London-Moscow route Apr. 1.

In the Far East, the Chinese Civil Air Service began regularly scheduled operations with the Il-18 on the Peking-Canton run on Dec. 1. In one trial flight conducted by the Communist Chinese on the Peking-Wuhan-Canton-

Shanghai-Peking route, the Il-18 flew the 2,700 mi. in six and one-half hours at an average speed of 420 mph.

The Chinese now plan to use the Il-18 as the backbone of civil air operations on both domestic and international routes. In announcing the success of the trial flights with the Il-18, the Chinese lost no opportunity to praise the Soviet planes and knock U.S.-built aircraft. Here is what one Chinese civil aviation official had to say of the subject:

"The success of the trial flight shows China's rapid development in aviation techniques. Since the growth of China's aircraft industry, old fashioned U.S.-made planes have been weeded out on practically all airlines in the country, and Soviet Il-14 passenger planes and Chinese-made airplanes have come into general use. Before the trial flight of the Il-18 passenger plane, China's civil aviation signaling and navigation systems were strengthened and new technical equipment added. . . ."

Air Route Growth

According to the Chinese, the nation's civil air routes have tripled to 22,370 mi. in the past 10 years, and the volume of freight transport has increased to a point almost 19 times that of 1950. From the operating statistics available, it is evident that the civil airlines are handling more cargo than passengers in the hustling reconstruction of Red China.

Peking, however, recently announced that "with the reduction of fares by an average of 40%, the number of workers, peasants and herdsmen traveling by air is increasing day by day."

The Chinese also are reportedly building the Soviet-designed An-2.

Meanwhile, the Russians are building up international propaganda behind the Il-18 in hopes of creating worldwide prestige for the airplane. Latest promotional effort was an announcement that a production model Il-18 transport airlifted a 44,100 lb. payload to an altitude of 39,370 ft. The Russians will file data on the flight with the Federation Aeronautique Internationale for certification as a world record.

In design and performance, the Il-18 is similar to the Lockheed Electra turboprop.

The Soviet plane is powered by four Ivchenko AI-20 turboprop engines at 4,000 eshp. each.

It is designed for medium range domestic and international routes. Range increases with reduced payloads permitting more spectacular operations on prestige-boosting missions.

The planes operated by Aeroflot has an 80-passenger configuration and fly at a normal cruise speed of 404 mph. at 26,000 ft.

Low Ton Mile Costs Reported For Convair 540 by Allegheny

Washington – Allegheny Airlines' third quarter operating statistics on its leased Convair 540 powered with Napier-Eland turboprop engines indicate the turbine-converted aircraft has produced an available ton mile cost of 12.59 cents as compared with a local-service airline average of 21.14 cents for all types of aircraft.

Civil Aeronautics Board figures, analyzed according to aircraft types, gave a comparable Fairchild F-27 average cost per available ton mile at 20.70 cents, DC-3 average costs at 21.96 cents and costs for Martin and Convair piston aircraft at an average of 19.54 cents. These direct operating costs include flying operations and direct maintenance, but exclude both depreciation and rental payments.

Convair turboprop with 44 seats cost 1.646 cents per available seat mile, according to the CAB figures. F-27, operated by Piedmont, West Coast, Bonanza and Pacific airlines with an average 36 seat capacity, produced a seat mile cost of 2.03 cents, while the DC-3 averaged 2.207 cents and the other aircraft types averaged 2.05 cents.

Allegheny's plans to operate the 540 with a 52-seat configuration would drop the cost per available seat mile on the Convair turboprop to an estimated 1.392 cents. The airline recently announced plans to purchase 11 Convairs, four of which will be converted by Canadair to Napier turboprop powerplants. Purchase also will include the leased aircraft which the company has been operating since July (AW Nov. 30, p. 40).

In terms of available ton miles per hour, the 540's speed of 232 mph. produced 1,338 ton miles on a daily utilization of a little more than six hours. In comparison, the F-27, at an average speed among the four carriers of 199.5 mph. and utilization rate of 5 hr. 54 min., handled 719 ton miles. Piston-engine Martins and Convairs, with average speeds of 182.8 mph. and a utilization of 5 hr. 28 min., produced an average of 751 ton miles.

Direct aircraft operating expenses, minus depreciation or rental fees on a revenue plane mile basis, amounted to 72.41 cents for the 540 turboprop and 74.64 cents for the F-27. However, Allegheny's direct maintenance costs of 22.43 cents have been tailored to its lease agreement with Napier and could change once ownership of the aircraft is assumed. Breakdown of flying operations' expense on a cents per revenue plane mile basis shows a cost of 49.98 cents for the Convair 540, lower than the 50.58 cents recorded by the piston-engine Convairs and Martins but higher than the F-27's average costs of 43.87 cents. Most of the cost gap came from higher fuel, oil taxes and insurance costs assumed by Allegheny for the aircraft.

Comparative DC-3 costs amounted to 37.47 cents.

During the third quarter the 540, which has a ton load capacity of 5.75 tons as compared with the average of 3.55 tons for the F-27, consumed 361 gal. of fuel per hour of flight with a mileage rate per gallon of 0.64. F-27 flights used an average of 251 gph. with a mileage rate of 0.8.

In terms of dollars per revenue plane hour, 540 direct operating expenses, minus depreciation or rentals, were $168.45 based on hourly flying costs of $116.28 and direct maintenance expense of $52.17. F-27 costs in this category came to $148.91 per revenue aircraft hour, with $87.52 in flying operations expense and $61.39 for direct maintenance.

CAB Examiner Raps Duplicate Cost Reports

Washington—National Airlines and Pan American Grace Airways have been strongly criticized by a Civil Aeronautics Board hearing examiner for duplicate reporting of interchange flight equipment costs for two aircraft used in the New York-Latin American market.

Basis for Examiner Edward D. Stodola's remarks and recommendations in the year old National-Panagra Accounting Investigation is the lease by National of a Douglas DC-6 and a DC-7 from Panagra since 1955 under "complicated" terms which Stodola said make it difficult to determine whether the agreement constitutes a straight lease or an installment purchase by National, with depreciation costs deducted from the eventual purchase price. Both carriers have thus been claiming the two aircraft along with depreciation in accounting reports to the Board, Stodola said, with Panagra basing its claim on legal ownership and National on a purchase clause in the interchange agreement.

The examiner said such duplicate reporting of the same asset by the two carriers is illegal and tends to affect the accuracy of Board statistics which are often utilized by other government agencies and given nationwide distribution.

Stodola told Board members that the agreement essentially constitutes only a

AIRLINE OBSERVER

► Heavy impact jet transports will have an airline business in 1960 by attracting new traffic and skyrocketing the number of available seat miles became evident for the first time during the month of November. During the month—when U. S. carriers were operating 155 turboprops and 68 turbojets—revenue passenger miles rose to 2.19 billion—a record 23% increase over last November's volume. At the same time, available seat miles showed the sharpest monthly gain in the history of air transportation with a 32% increase over the available seat miles operated in the same month of last year. The real danger—one that all carriers are now girding for—lies in the resultant effect on load factors. November's load factor plummeted 4.22 points from last November's figure to 57%—the lowest figure reported by the trunklines since May, 1958. November also was the second month in the past 14 months that the industry has failed to show a monthly load factor increase.

► Domestic trunkline common stocks listed on the New York Stock Exchange held close to the year's low last week in a market that was moderately heavy. With the possible exception of United and Western listings, airline stocks were generally avoided by most investors who appeared to confine buying activities to top-rated securities.

► Air Transport Assn. board of directors last week approved a 1960 budget of $2 million, "slightly" lower than 1959's budget. Total of $135,000 was authorized to cover the cost of an advertising program promoting the use of air parcel post.

► Indications are strong that the merger of Pan American World Airways' Atlantic and Pacific-Alaska divisions (AW Dec. 14, p. 38) will be followed by the elimination of the Latin American Division once the majority of the carrier's piston-engine fleet is retired. At that time, all engine overhaul will be handled at the Idlewild base, all airframe overhaul at Miami.

► Charter or purchase of a used piston-engine aircraft is being considered by the French automobile manufacturer, Renault, for shipment of parts into the U. S. The car maker now ships parts by commercial airline and believes the used-plane market may provide a bargain that would make it more economical to operate its own airlift.

► French officials insist that the joint Franco-German development of an eight-ton cargo aircraft, the Transall (AW July 13, p. 61), is continuing despite unofficial reports from Bonn that German interest in the project is lagging. Reportedly, the twin-turboprop Transall—Transport Alliance—is being built in three prototypes. The first is scheduled to be built in France by Nord Aviation, the second and third in Germany by Weser, Hamburger and Stiebel. Plans also call for Italian participation in the program if it reaches full-scale production.

► Railway Labor Executive Assn. will support Flight Engineers International Assn. move to dismiss a petition by the Air Line Pilots Assn. to broaden its craft to include flight engineers for purposes of collective bargaining. A special board named by the National Mediation Board is now hearing the case which directly involves United Air Lines. The railroad unions are intervening because of the effect the Board determination sought by the pilots' union might have on craft rights in the railroad industry.

► Aeroflot reports its twin-turbojet powered Tu-104s carried about 5,000 passengers on the Moscow-Cairo run during the first year of direct air service between the two capitals.

► Pilots have submitted to Capital Airlines a copy of a mandate resolution adopted by the Master Executive Council of the pilot group stating that after Apr. 1 no Viscounts which are not equipped with all-weather radar will be flown whenever weather forecasts indicate air turbulence. However, the airline is now installing radar equipment on its fleet and anticipates the program will be completed well before the pilots' target date.

lease arrangement since Panagra still retains title to the aircraft and that National is not building any substantial equity in the equipment because of low rental payments tailored to National's costs, including depreciation based upon available seat miles of operation.

Finding that the aircraft should properly be reported as Panagra assets, the examiner also recommended that they be depreciated in CAB reports in the amount of depreciation included in the National payments as opposed to Panagra's request for a seven-year depreciation rate with a 15% residual value.

Compliance with the recommended depreciation rate would avert any capital loss on retirement of the equipment by Panagra, Stodola said, since the value of the aircraft on the carrier's books should never exceed the balance of the purchase price owed by National.

SHORTLINES

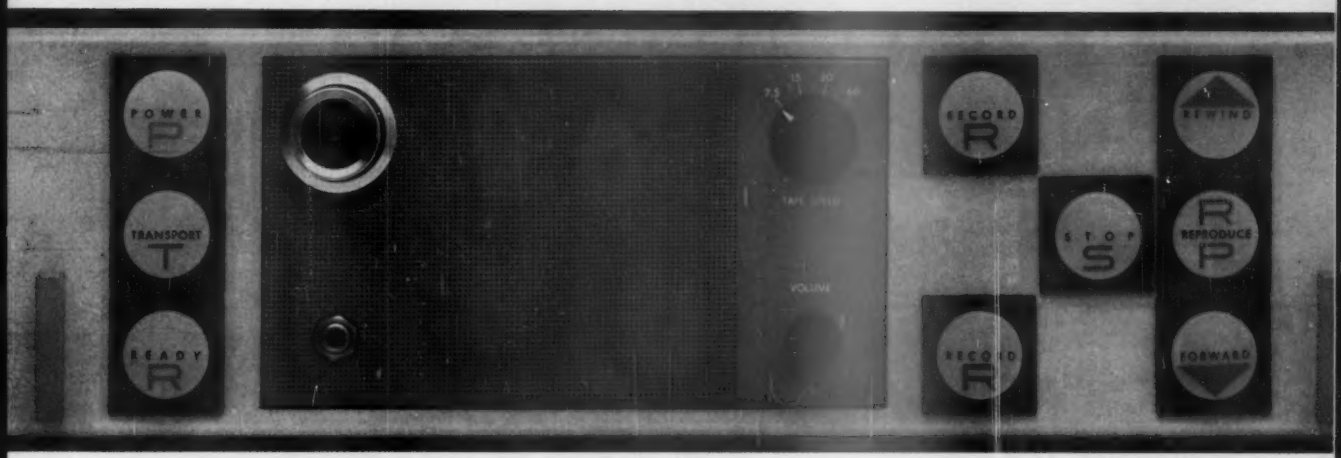
► **British European Airways** has arranged an all-inclusive package tour with Intourist, Soviet state-owned tourist agency, which covers eight days in Moscow. Round trip London-Moscow air fare has been set at $252.

► **Federal Aviation Agency,** in a new ruling, permits certificated mechanics holding inspection authorizations to inspect and certify the airworthiness of single-engine fixed-wing aircraft. The previous regulation only permitted inspection by a manufacturer, a certificated repair station or a certificated air carrier.

► **Los Angeles Board** of Airport Commissioners has approved the request of Helicabs, Inc., of Glendale, Calif., for operation of helicopter taxi service from Los Angeles International Airport to points in the downtown area. Helicabs will operate with eight three-passenger Bell 47-Js.

► **Pan American World Airways** recently carried 12,035 lb. of cargo and mail on its Flight 100 from New York to London.

► **University of Michigan** has announced that it intends to continue operating Willow Run Airport for general aviation purposes even if commercial airline operations are transferred to the newer Detroit Metropolitan Airport. The university said Willow Run would be developed as a center for personal, corporate, business and other types of aircraft. It also will serve as a base for companies which sell, lease, and maintain planes, including specifically Air-O-Fleet and Great Lakes Airmotive.



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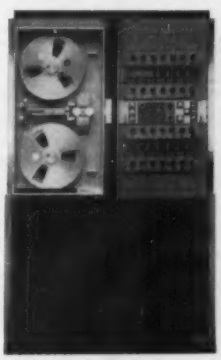

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AMPEX

U. S., Russian Space Efforts Compared

By Homer E. Newell, Jr.

The U.S. has been using sounding rockets for upper air research and rocket astronomy since the close of World War II. WAC Corporal, V-2, Viking, Aerobee, Aerobee-Hi, Nike-Deacon, Nike-Cajun, Nike-Asp, and Rockoons were used. Altitudes attained were below 200 mi. for the most part.

Many hundreds of rockets were fired prior to the start of the International Geophysical Year; an additional 200 were fired as part of the International Geophysical Year program. Current rate of rocket soundings is somewhat below 100 per year.

Higher altitude rockets are being introduced into the work to extend the atmospheric observations to one to several thousands of miles altitude. Launchings have been carried out at White Sands, N. M.; Wallops Island, Va.; San Nicolas Island, Calif.; Cape Canaveral, Fla.; Fort Churchill, Canada; Guam; and from shipboard in the North Atlantic, the Mid and South Pacific, and the vicinity of Antarctica.

Program Results

The U.S. program has produced hundreds of research papers and reports giving results on the pressure, temperature, density, winds, and composition of the upper atmosphere; the ionosphere; the earth's magnetic field; the aurora and air-glow; cosmic rays; micrometeors; solar radiations; and ultraviolet astronomy.

Some experiments have been carried out on modifying the upper atmosphere by the release of special chemicals, and on modifying the radiation belt by nuclear explosions. Some biosciences experiments have been performed.

The USSR has also been carrying out a rocket sounding program since the last war. Although the precise number of rocket soundings to date is not known, they number in the hundreds. Firings have been made from Franz Josef Land and from Mirny in Antarctica, as well as from European USSR.

The Soviets have perfected a meteorological sounding rocket that is used for more or less routine soundings of the atmosphere to measure air pressures, densities, and temperatures up to 35 mi. altitude. In addition, their "geophysical rocket" is capable of carrying ton-and-a-half payloads up to 300 mi. altitudes.

From their counding rocket programs the USSR has obtained a broad collection of results. The meterological soundings have produced detailed data on the structure of the upper atmosphere just above the troposphere, showing its temporal and seasonal variations.

The geophysical rocket program has provided considerable information on the very high atmosphere, including the ionosphere. The description of one of the geophysical rocket payloads is so similar to the description of Sputnik III and its instrumentation as to lead one to conjecture that the payload may have been essentially the Sputnik III payload. Whether or not this is the case, the instrumentation provided for a broad range of measurements on the ionosphere, atmospheric structure, energetic particles, and the earth's magnetic field.

The USSR rocket program has also included considerable work on biological researchers. There have been some 20 tests in which dogs, and/or rabbits were sent aloft and recovered for study. During the flight the behavior of the animals was telemetered to ground.

Dr. Homer E. Newell, Jr., is assistant director for space sciences in the National Aeronautics and Space Administration. This comparison of space science results achieved by the U. S. and USSR, prepared for NASA, is one of a series of such studies of the space sciences done by Dr. Newell. Prior to joining the space agency shortly after it was created, Dr. Newell was acting superintendent of the Atmosphere and Astrophysics Division of Naval Research Laboratory and science program coordinator for Project Vanguard. He holds bachelor and master of arts degrees from Harvard University and a doctorate in mathematics from the University of Wisconsin.

The USSR launched the first successful artificial earth satellite. To date the USSR has successfully launched three earth satellites, and three space probes. Two of the space probes achieved earth escape velocity; the first passed within two or three moon diameters of the moon. The second Soviet space probe actually hit the moon. The third space probe was launched so as to pass close enough to the moon to take pictures of the unseen side of the moon's surface, then to loop around the moon returning to the earth. The lunar pictures were successfully obtained.

The U.S. has to date successfully launched 13 earth satellites—namely five Explorers, three Vanguards, Project Score, and four Discoverers; and three space probes, all called Pioneers. Only one of the space probes achieved earth escape velocity, passing by the moon at some 37,000 mi. distance.

Both the U.S. and Soviet satellites and space probes have produced valuable scientific results. Included are some spectacular discoveries and achievements, some of which are given in the accompanying Table 1. In addition to the more spectacular output, these satellite and space probe flights are turning out a steady flow of information and results that build up gradually to an impressive advancement of mankind's knowledge of the earth and outer space. Some of these are listed in Table 2.

Problems Under Attack

In attempting to compare the relative stages of advancement of the U. S. and USSR in space research, one might proceed by trying to list item by item the individual results from the two programs and to relate these results item to item.

This would turn out to be difficult even if one were sure that all the results obtained by the Soviets were actually at hand, for there would be many observations obtained by the Russians that had not yet been obtained by the U. S., and conversely, many obtained by the U. S. that had not yet been obtained by the Russians. A more effective, and perhaps more significant way of comparing the relative stages of advancement, would be to isolate the general areas of investigation and the general problems being attacked by the two countries.

Taking this approach one can say that the U. S. and the USSR appear to be at about the same stage of advancement in upper air research. The

U. S. results on the atmosphere below 200 mi. appear to be more detailed and complete, but the Soviets have made higher altitude measurements by means of their geophysical rocket.

The Soviets appear to have done far less than the U. S. on solar radiations, but the USSR has done much more than the U. S. on bioscience experiments, having conducted numerous flight tests in which dogs were carried aloft in rockets and safely recovered. The USSR has carried the technique of ejecting instrumented packages from the rocket carrier farther than has the U. S., which has carried the technique of telemetering to a high degree of refinement.

Likewise, the U. S. and the USSR seem to be at about the same stage of advancement in studies of the earth's environs where satellite techniques are adequate for making the necessary observations. In fact it may be that in this regard the U. S. has the slight edge. The big advantage the Soviets have in attacking these problems lies in their greater payload capacity. On the other hand, the U. S. has launched many more satellites than the Soviet Union.

In the deep space probe work, the USSR has definitely taken the lead. This is directly attributable to their clear lead in vehicle technology.

Table 3 provides a comparison of the states of advancement of the U. S. and the USSR.

A review of Table 3 shows fairly clearly that the U. S. and USSR scientist are at about equal stages of advancement in the problems they are attacking or are about to attack in space research. As groups they undoubtedly have comparable competencies and understandings of the significant problems that ought to be tackled. Their instrumentations are roughly equivalent, although the U. S. may have a slight edge here, as indicated by the fact that the USSR quite often simply copies U. S. equipment for its own instrumentation.

The conclusion follows then that the side that has the more advanced technology in the way of payload capabilities, guidance, etc., will have the distinct edge and by virtue of the increased flexibility and capabilities provided by the more advanced technology will forge steadily ahead. Thus, one may predict a time lead in vehicle technology will be transformed into a corresponding time lead in the exploration and investigation of outer space.

Significant Firsts in Sounding Rocket, Satellite, and Space Probe Research—Table 1

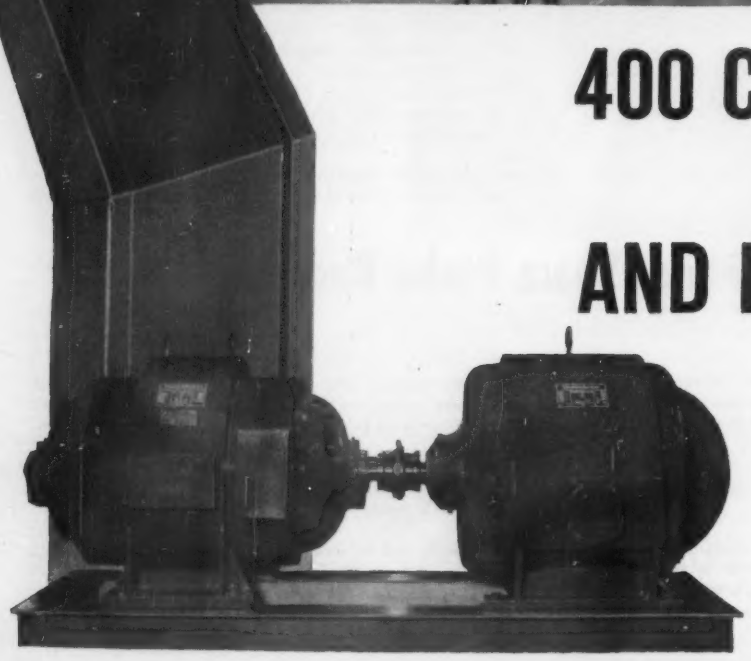
UNITED STATES	USSR
1. A number of firsts in high altitude rocket research, including: First detailed photo of solar ultraviolet spectrum. First photo of complete tropical storm. First penetration of equatorial ionospheric current sheets. First detection of X-rays in high atmosphere. First detection of auroral particles in high atmosphere.	1. First artificial earth satellite.
2. Discovery of the Van Allen radiation belt.	2. First lunar near miss.
3. Discovery that the Van Allen radiation belt consists of at least two zones.	3. First lunar impact.
4. Performance of the Argus experiments.	4. First pictures of the hitherto unseen side of the moon.
5. The first precise geodetic use of artificial earth satellites (Vanguard I) to obtain refined information on the size and shape of the earth, providing an improved value for the flattening and showing that the earth is actually slightly pear-shaped.	5. First detection of what may be a current ring about the earth (the Chapman-Stoermer ring).
6. First achievement of an elementary communication satellite, in Score.	6. First routine recovery of large animal (dogs, and rabbits) from high altitude rocket flights. 7. Development and routine use of a meteorological sounding rocket, recoverable and reflyable. 8. First launching of a large animal (Laika) in a satellite of the earth. 9. First high capacity, maneuverable, heavily instrumented, spacecraft with fully successful long-range communications (Lunik III).

Sounding Rocket, Satellite, Space Probe Results—Table 2

UPPER ATMOSPHERE

UNITED STATES	USSR
1. Rocket observations have been made of pressure, temperature, density, composition, and winds of the high atmosphere at a wide variety of locations, both day and night, and in the various seasons.	1. Rocket observations have been made of pressure, temperature, density, composition and winds of the high atmosphere at a wide variety of locations, both day and night, and in the various seasons.
2. Upper air densities have been obtained from the tracking of both U. S. and USSR satellites.	2. Upper air densities in the higher latitude regions obtained from drags on Sputniks I and III.
3. It has been shown that the radiation belt may account for much higher atmospheric temperatures observed in the auroral zone atmosphere than in the high atmosphere above the middle and equatorial regions.	3. High enough flux of low energy electrons measured with Sputnik III instruments in the northern regions to account for the higher atmospheric temperatures there.

(Continued on p. 41)



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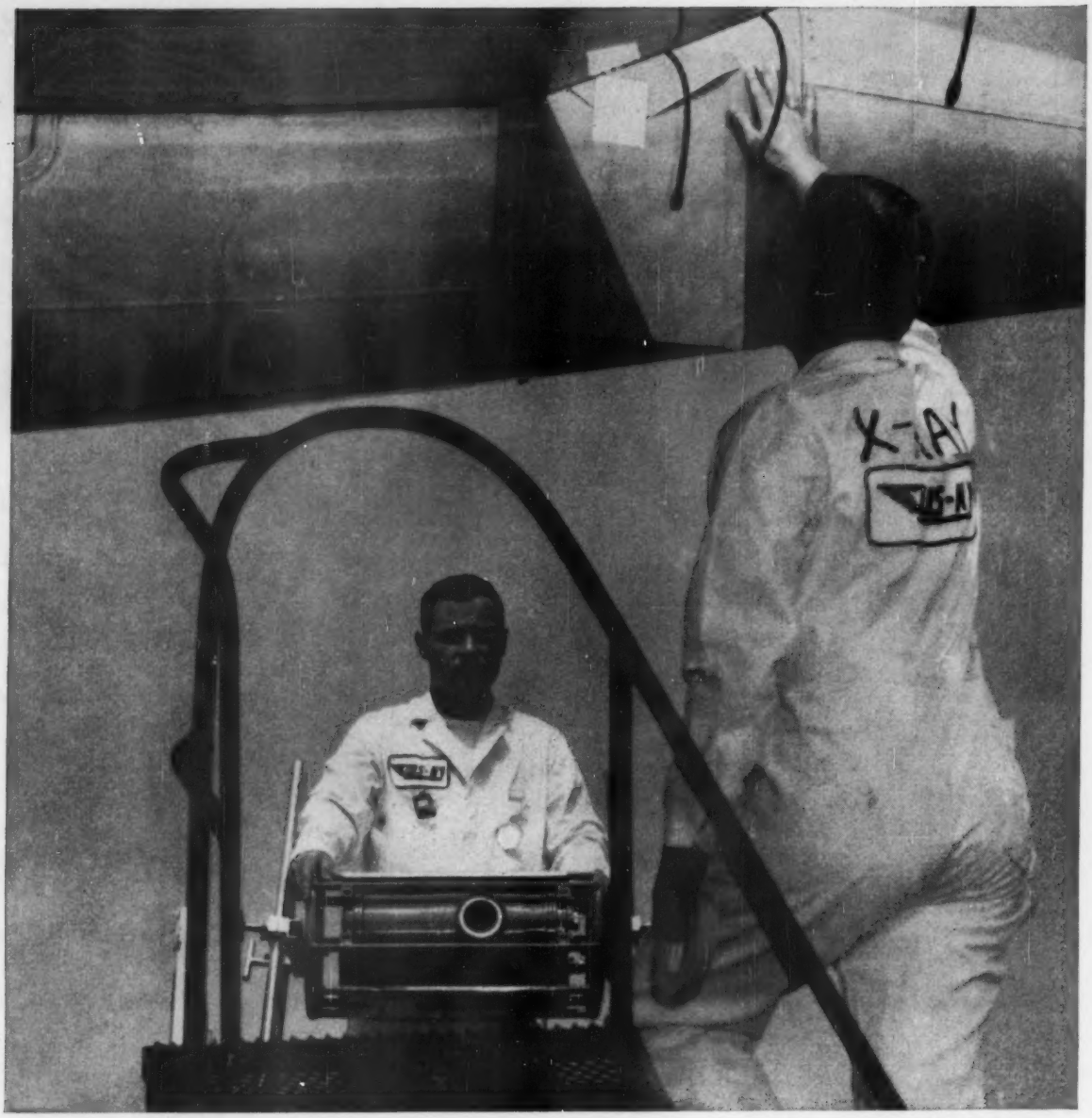
UNITED STATES	USSR
4.	4. Direct measurement of upper air densities made with gages in Sputnik III, for heights up to 355 km.
5. Fluctuation in satellite drag, hence presumably upper air densities, have been shown, from observations on Vanguard I and Sputnik II, to be directly correlated with fluctuations in the 10 cm. radiation from the sun, and hence solar activity.	5.
6.	6. The routine meteorological sounding rocket has been used to give atmospheric structure data at middle-European, Arctic, and Antarctic locations showing seasonal variations as well as geographic. It turns out that the seasonal variations are different for the different altitude ranges.
7. From both satellite and rocket observations high altitude air densities have been shown to vary widely with time of day, season, and geographic position.	7.
8. The amounts of diffusive separation both below and above the E region of the ionosphere have been measured in sounding rocket experiments, and shown to be very slight below the E region and quite pronounced above altitudes of 110 to 120 km.	8. Diffusive separation in the upper atmosphere below the E region has been measured with results that agree in general with the U. S. observations.
IONOSPHERE	
1. Extensive electron density data have been obtained for a number of locations from rocket soundings.	1. From rocket soundings electron densities have been obtained up to and above the F region maximum.
2. From radio signals of both U. S. and USSR satellites, propagation characteristics of the ionosphere and electron density distributions have been obtained.	2. Electron densities above 300 km. were obtained by observation of the radio signals of Sputniks I and III.
3.	3. Observations on Sputnik I showed 3.5 times as many electrons above the F region maximum as below.
4. The heavy ions in the ionosphere above White Sands and Fort Churchill have been identified up to the F region in rocket sounding experiments.	4. The ionic composition of the ionosphere has been measured in sounding rockets to above the F region maximum.
5.	5. Sputnik III observations showed that the predominant ion from 250 to 950 km. is positive atomic oxygen.
6.	6. In Sputnik III the satellite potential in the daytime ionosphere was observed to be as much as minus seven volts.
7. Very low frequency propagation data were obtained from Explorer VI.	7.
8.	8. In the second Lunik, evidence of a lunar ionosphere was obtained.
MAGNETIC FIELD	
1. Data on earth's magnetic field were obtained from Pioneer I and Explorer VI, and a great deal of additional high quality data are being obtained from Vanguard III.	1. Data on earth's magnetic field obtained from Sputnik III.
2. By their magnetic effect, electric current flows were plotted in the E and lower F regions, in rocket sounding experiments in the equatorial regions.	2.
3.	3. On Mechta, measurements were made of earth's magnetic field and its extension into space. A marked dip in the field was discovered in the region of the radiation belt, indicating perhaps the existence of a current ring such as postulated by Chapman.
4. Rocket measurements of the earth's magnetic field have been made in the auroral regions.	4.
5.	5. Lunik II, on its plunge to the surface of moon, showed that the lunar magnetic field is not greater than 50 gamma.
COSMIC RAYS	
1. Extensive data on cosmic ray intensities, composition, and interactions with matter were obtained from sounding rockets in various locations and throughout all the seasons.	1. Cosmic radiation measurements have been made in USSR sounding rockets.
2. The cosmic ray count was obtained above the atmosphere with counters in Explorer satellites and Pioneer probe.	2. The cosmic radiation was measured in Soviet satellites and space probes.

(Continued on p. 43)



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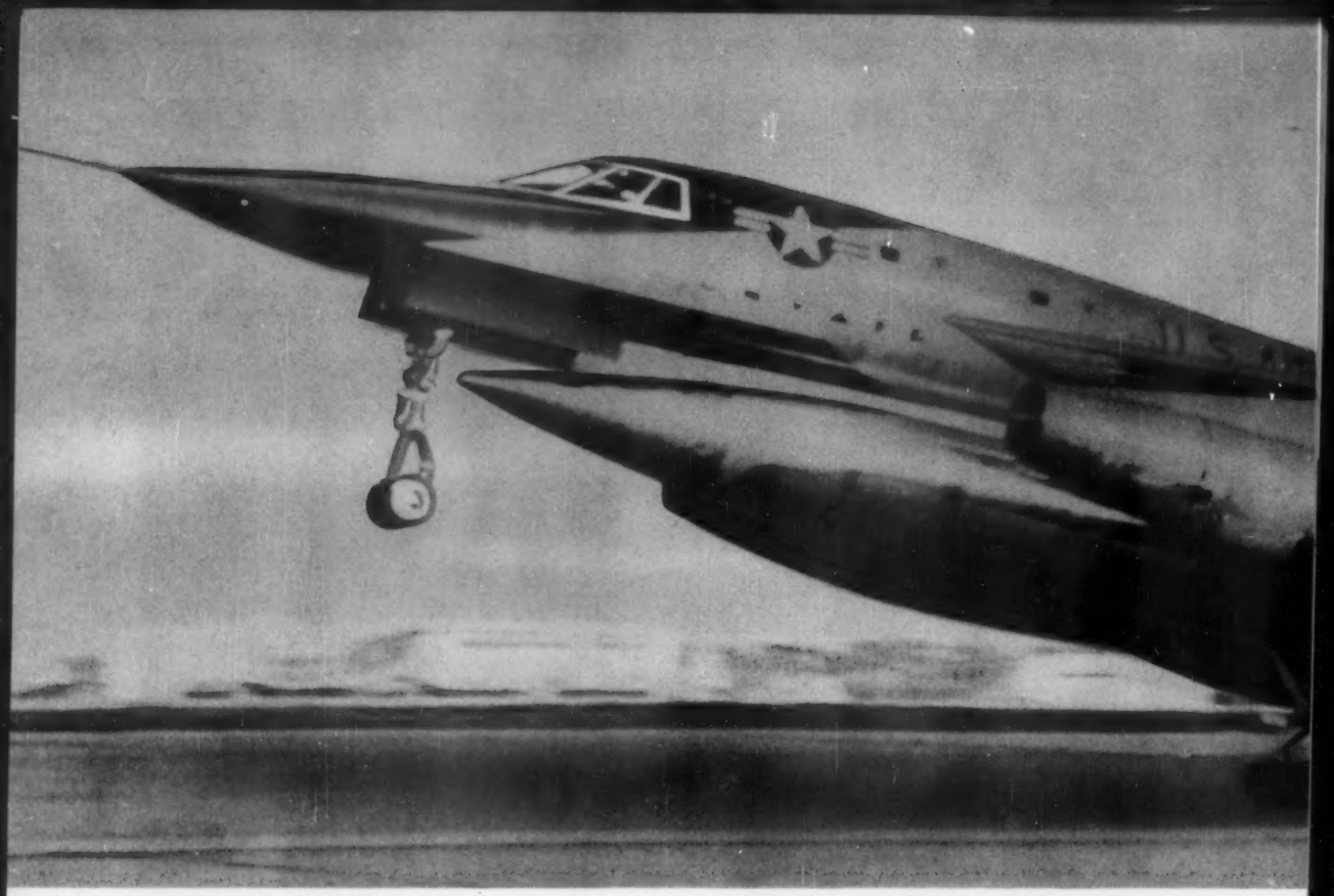
Ansco

X-ray

UNITED STATES	USSR
3. Cosmic ray counts in the first Explorers gave discovery of the radiation belt.	3. Sputnik II observations showed an increase in counting rate with height (this being at the time an unrecognized hint of the presence of the radiation belt).
4. Details on the cosmic radiation as a function of time and position in space have been obtained from Explorer VI, and are being obtained from Explorer VII.	4. Sputnik III and cosmic rockets provided measurements on the heavy nuclei in the cosmic radiation.
RADIATION BELT	
1. Radiation belt discovered with instruments in Explorer I.	1. Abnormally high cosmic ray counts were observed in Sputnik II, particularly at the high latitudes. Sputnik III showed a very high electron flux in the northern latitudes.
2. A great amount of additional detail obtained on belt in Explorers III and IV, and the Pioneer probes. Extent of radiation belt shown by Pioneer I. Pioneer III showed belt to consist of at least two zones.	2. Sputnik III, Mechta, and other Soviet satellite and space probe observations confirm the U. S. findings.
3. Pioneer IV showed the extent of the outer radiation belt to have increased greatly following a five-day period of high solar activity, thus proving that the outer belt is of solar origin.	3.
4. Argus experiments showed individual inner zones of the radiation belt to be very stable.	4.
5. Argus observations lend support to conclusion that inner radiation belt produced by cosmic rays. See No. 7 below.	5.
6. Detailed energy spectrum of radiation in radiation belt was obtained by Explorer VI.	6.
7. Sounding rocket observations showed that the energetic particles of the inner radiation belt are protons of energy spectrum expected from beta decay of neutrons, hence supports cosmic ray origin for hard components of inner belt.	7.
8. Extensive additional information on the radiation belt was obtained from Explorer VI and is being obtained from Explorer VII and Vanguard III. Huge variations of many orders of magnitude in counting rates were observed in outer zone.	8.
9. Radiological hazard of radiation belt estimated to be not serious for a direct traverse of the belt; but quite serious for a space station that spends a lot of time in the belt.	9. Radiological hazard of radiation belt estimated to be not serious for a direct traverse of the belt; but quite serious for a space station that spends a lot of time in the belt.
10.	10. The moon was shown not to have a radiation belt detectable within the sensitivity of Lunik instruments.
AURORA	
1. Rocket soundings have been used to study the electromagnetic and particle radiations in the aurora. It was found that soft radiation flux above 40 km. was many times the primary cosmic ray count.	1.
2.	2. A very high flux of low energy electrons was observed in Sputniks II and III. This flux was taken to be the cause of the very high atmospheric temperature in these regions.
3. The particles in the outer radiation belt have been shown to be the likely immediate cause of the aurora.	3. The particles in the outer radiation belt have been shown to be the likely immediate cause of the aurora.
GEODESY	
1. Vanguard I observations give an oblateness of the earth of 1/298.3.	1.
2. Vanguard I observations show the earth to be pear-shaped with a 50 ft. peak at the north pole, and a 50 ft. flattening at the south pole; this appears to imply an internal strength to the earth, rather than a free flowing plasticity.	2.
METEORS	
1. A fairly low count of micrometeors corresponding to a total influx of 1,000 to 10,000 tons of material per day, from Explorer and Pioneer observations.	1. Influx of material per day indicated by Sputnik III observations in general agreement with the U. S results.
2. A very large amount of additional data are being obtained from the Vanguard III instrumentation.	2. Additional measurements made in Soviet cosmic rocket flights.

(Continued on p. 47)



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cipitation hardenable Stainless Steel, as well as other grades of chrome-nickel Stainless Steels for high speed aircraft and missiles, and USS Strux, an alloy steel with a 280,000 minimum psi tensile strength that is ideal for landing gears.

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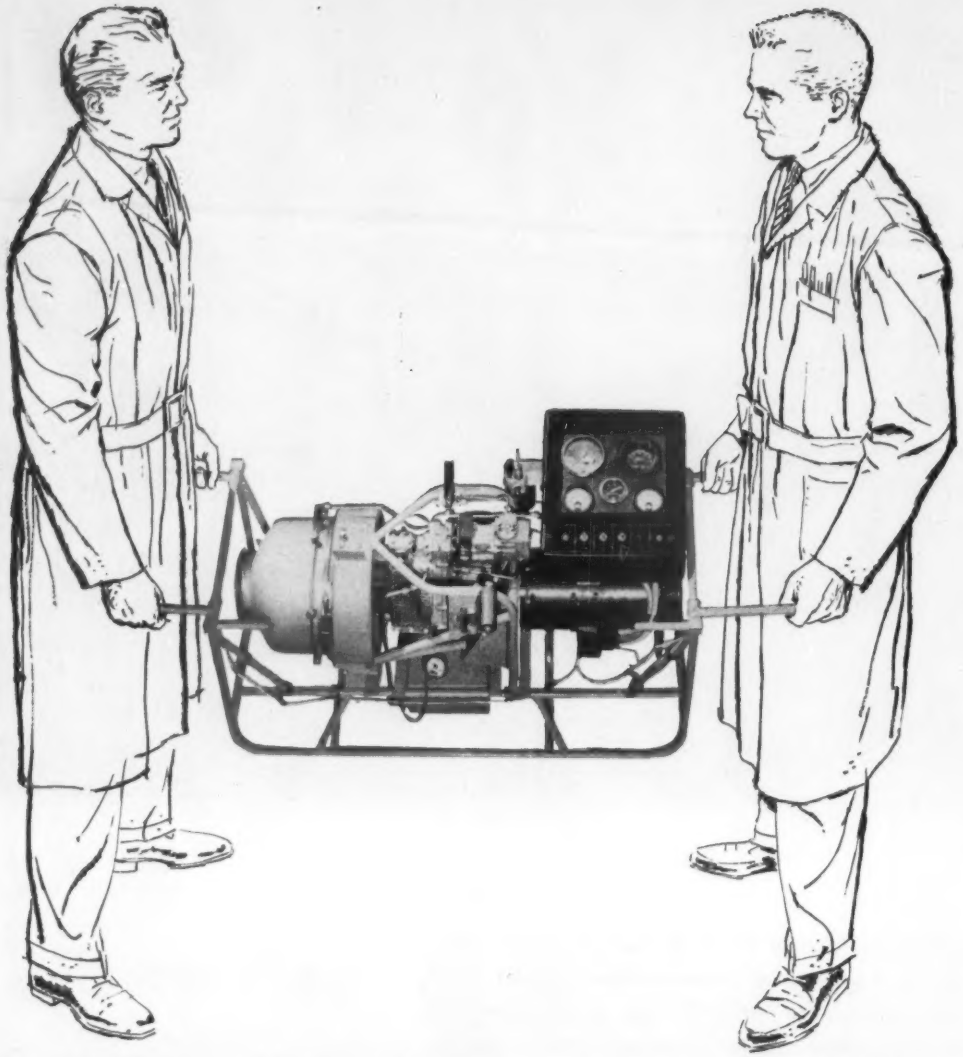

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UNITED STATES	USSR
ASTRONOMY	
1. In sounding rocket experiments ultraviolet sources in the sky have been detected and plotted.	1.
2. The solar spectrum has been observed and photographed down to 303 angstroms.	2.
3. Solar radiations have been observed and measured in the X-ray regions.	3.
LUNAR EXPLORATIONS	
1.	1. First photos taken of the hitherto unseen side of the moon.
2.	2. The lunar magnetic field shown to be no greater than 50 gamma.
3.	3. Lunar ionosphere detected.
MISCELLANEOUS EXPERIMENTS	
1. The Argus experiments were carried out.	1.
2. Sodium vapor was released in the high atmosphere and observed to measure its radiations, atmospheric winds and diffusion.	2. Sodium clouds were released from Luniks II and III and observed from the ground.
3. Various chemical contaminants were released in the high atmosphere to study the photochemical reactions that resulted.	3.
BIOSCIENCES	
1. On numerous sounding rocket flights biological specimens of seeds, fruit flies, etc., have been flown and recovered for study. Larger animals, such as rats and monkeys, have been flown for study of their behavior and the effects of the flight environment on them. Recovery of such animals has been effected on numerous occasions.	1. Large numbers of sounding rocket experiments have been carried out with dogs and rabbits, in which the animals were both studied during flight and recovered after flight for further study.
2.	2. Observations were made on the behavior of Laika, particularly heartbeat and respiration, in Sputnik II.
ENGINEERING DATA	
1. U. S. satellites show that moderate temperatures can be achieved in orbiting vehicle.	1. USSR satellites and space probes show that moderate temperatures can be achieved by appropriate engineering.
2. Elementary communications link checked out in Project Score.	2.
3. Based on radiation belt data, it is deduced that satellites may charge to a potential of some hundreds of volts in the radiation belt.	3. Sputnik III measurements show that in the daytime ionosphere the satellite acquired an appreciable negative charge corresponding to a negative potential of several volts.
4. The meteor erosion and puncture problems have been shown in general to be not particularly serious.	4. The meteor erosion problem appears to be not particularly serious.
5. An elementary TV scanner was checked out in Explorer VI, while some of the basic elements of a meteorological satellite were checked out in Vanguard II.	5.
6.	6. Automatic photography of the moon and the televising of the photographs obtained back to earth has been achieved.
7. Solar cells have been shown to be a practical, reliable source of power.	7. Solar cells have been shown to be a practical, reliable source of power.
8.	8. A complete spacecraft, maneuverable, with temperature control, power supply, long-range communications link, complicated instrumentation, etc., has been engineered and flown successfully, namely, Lunik III.
9. It appears that the radiological hazard to space vehicle crews traversing the radiation belt directly may be relatively low, while the hazard to those in a satellite orbiting through the radiation belt would be quite serious. In addition, marked increases in proton intensities of the cosmic radiation found at the time of solar activity may be a very serious radiological hazard: dose rates of 1,000 roentgens per hour.	9. It appears that the radiological hazard to space vehicle crews traversing the radiation belt directly may be relatively low, while the hazard to those in a satellite orbiting through the radiation belt would be quite serious.

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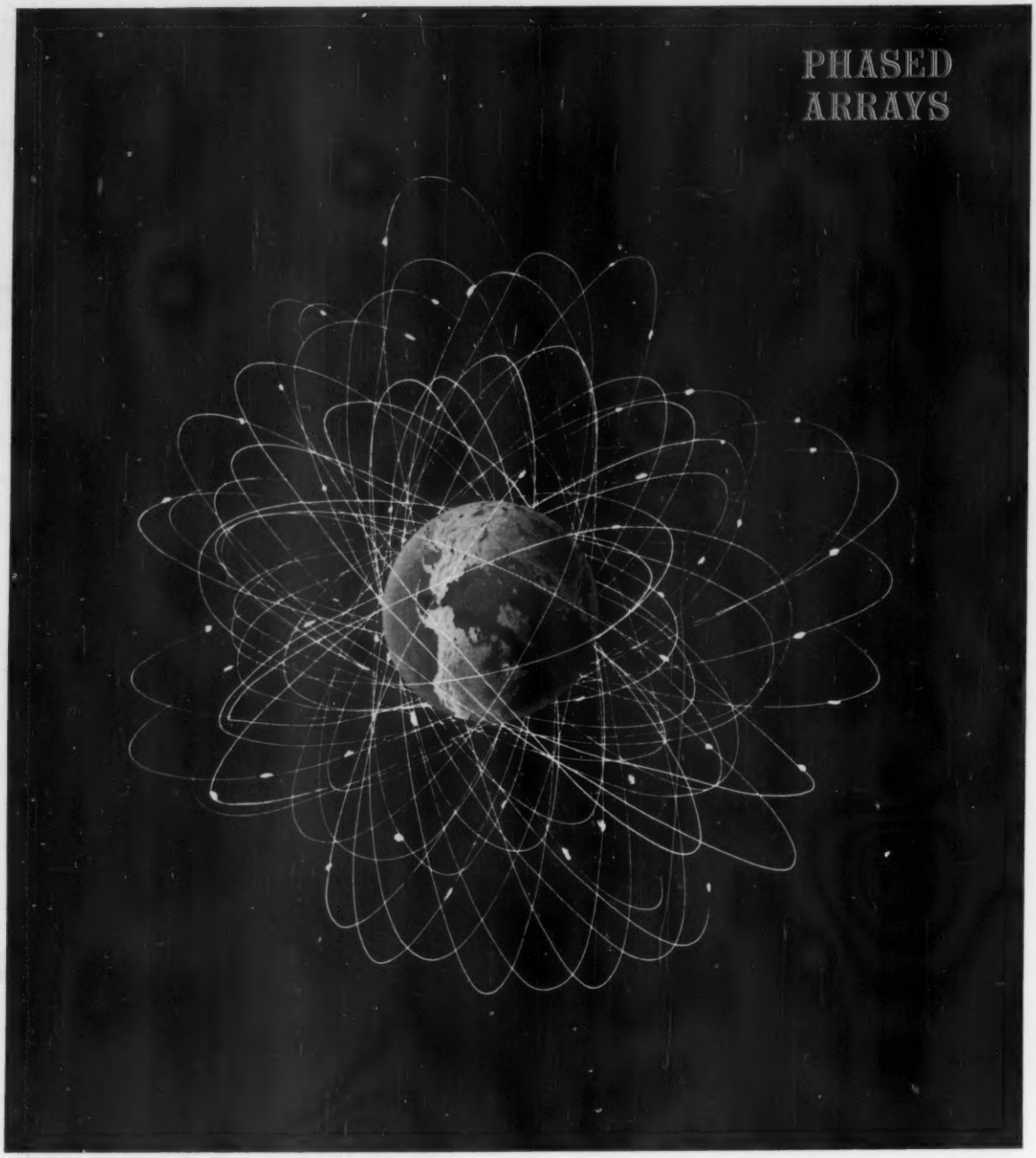

what's where in space. We soon will face the crucial problem of identifying and keeping track of hundreds of man-made objects in outer space. Phased Array Radar techniques, developed at Bendix Radio, offer a solution. If many widely spaced satellites or missiles hurtled over the horizon in the same minute, a tremendously high-powered Bendix* radar, directed by a computer, could acquire, identify, track and catalog each one without losing previously acquired targets. The Bendix Radio Phased Array Radar offers the most versatile 3-D data gathering system yet devised. It searches and tracks multiple targets simultaneously. It can provide long-range communications at the same time. If your organization deals in advanced operational concepts and weapons systems, you're invited to contact us to learn more of this latest Bendix space development.

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UNITED STATES	USSR
METEOROLOGY	
1. Numerous sounding rocket photos of cloud formations and significant weather areas have been taken. In particular a composite photo from one sounding rocket showed a completely developed tropical storm approaching hurricane proportions.	1.
2.	2. A meteorological sounding rocket was developed and has been used on a routine basis for meteorological studies.
3.	3. Detailed measures of pressures and temperatures have been obtained with the meteorological rocket for Antarctic, Arctic, and middle European locations.
4. Cloud picture data were obtained in Vanguard I, but motions of the satellite have so far prevented reducing the data to useful pictures. Also, very low resolution, elementary television pictures have been taken of cloud formations as seen from Explorer VI. One of these pictures was assembled and released.	4.

Problems Currently Under Attack — Table 3

UNITED STATES	USSR
UPPER ATMOSPHERE	
1. A detailed study of the structure, winds, and composition of the ionospheric regions and beyond in the earth's atmosphere is under way by means of sounding rockets and earth's satellites.	1. A detailed study of the structure, winds, and composition of the ionospheric regions and beyond in the earth's atmosphere is under way by means of sounding rockets and earth's satellites.
2. Work is under way to develop a routine rocketsonde for synoptic studies of the lower portion of the upper atmosphere in association with meteorological soundings.	2. The USSR has already achieved the development of a routine rocketsonde for meteorological type soundings into the lower portion of the upper atmosphere.
IONOSPHERE	
Intensive rocket and satellite studies of the ionosphere in the F region and beyond are under way.	Intensive rocket and satellite studies of the ionopshere in the F region and beyond are under way.
MAGNETIC FIELD	
The U. S. has used research coils, saturable core magnetometers and proton precision magnetometers in its measurements of the earth's magnetic field. The U. S. is preparing to use a much more sensitive instrument, the alkali vapor resonance magnetometer, for further studies of magnetic fields in space and to measure the magnetic field of the moon.	The USSR has also used standard type magnetometers and proton precession magnetometers for observations of the earth's magnetic field. The USSR has made a measurement to detect the lunar magnetic field, finding none to within the sensitivity of their instruments. It is not known whether the USSR is preparing to use the alkali vapor magnetometer in the near future.
COSMIC RAYS	
Balloon, sounding rocket, and satellite observations of the intensity, nature, and effect of cosmic rays are under way.	Balloon, sounding rocket, and satellite observations of the intensity, nature, and effect of cosmic rays are under way.
RADIATION BELT	
Detailed study of the radiation belt by means of sounding rockets, satellites, and space probes, with occasional use of controlled experiments is under way.	The USSR made intensive studies of the radiation belt in Sputnik III, but at the present time appears to be investigating the belt incidentally as part of their concentration on deeper space missions, namely on their Lunik flights.
AURORA	
U. S. scientists are tackling the problem of both vessels and ultraviolet auroral radiations, the particles connected with the aurora, and the ultimate origin of the aurora.	The USSR scientists are tackling the same problems.
GEODESY AND CELESTIAL MECHANICS	
U. S. is continuing use of satellites for geodetic studies.	The USSR shows skill in applications of celestial mechanics, as witnessed by their ability to launch Lunik III with the accuracy achieved, and to predict the motions of the Lunik III spacecraft.
METEORS	
The U. S. continues to collect data on meteors in space, using a wide variety of experimental equipment.	The USSR has made an intensive study of micrometeors in their satellites and space probes, appearing to attack the general problem very much along the lines followed by the U. S.
ASTRONOMY	
Active rocket astronomy in being. Orbiting telescopes, solar, and astrophysical observatories being worked on.	Unknown.

(Continued on p. 50)

UNITED STATES	USSR
LUNAR EXPLORATION	
The U. S. is preparing to conduct intensive investigations of the moon, but the actual observation of the moon from space vehicles is yet to begin.	The USSR has already achieved significant steps in its investigation and study of the moon. It may be presumed that the Soviets will continue their vigorous efforts in this area.
PLANETARY INVESTIGATIONS	
U. S. has minimal capability in this area at present, and on the present schedule planetary work is proceeding at a very low pace.	The USSR has an advanced capability in this area, and has declared its definite interest in planetary research.
MISCELLANEOUS EXPERIMENTS	
U. S. using upper atmosphere regions for controlled chemical and Argus-type experiments. Also planning relativity and gravity experiments.	Unknown.
BIOSCIENCES AND MAN-IN-SPACE	
The U. S. has a first stage man-in-space program in Project Mercury. Support work of a research type is being carried out in the Discoverer program. Some experimental work is being carried out in sounding rocket flights. A well rounded, fully developed program of research in both biotechnology and biosciences is yet to be worked out.	The USSR has a highly active program of research on animals under rocket flight and satellite conditions. It is not known how fully developed their biotechnical and fundamental biosciences programs are. It is expected, particularly from recent news releases, that the USSR does have a man-in-space program.
METEOROLOGY	
The U. S. is developing rocket photographic techniques for meteorological purposes. The U. S. is developing a meteorological sonde for synoptic soundings. The U. S. is conducting fundamental satellite experiments associated with meteorology, and is taking the initial steps in the development of a meteorological satellite system.	The USSR has already developed a working meteorological rocketsonde, which they have already put to extensive use. It is not known what the USSR is doing in the matter of developing a satellite meteorological system.
COMMUNICATIONS	
In its rocket, satellite, and space probe telemetry the U. S. has shown good capability. Long-range communication systems are being worked on for deep space probes. Communication satellite systems are being worked on.	The USSR rocket, satellite, and space probe telemetry has been successful. In particular the communications and telemetry probers of Lunik III appear to have been worked out with a high degree of competence. It is not known whether they are developing a communication satellite system, but it may be presumed that they are.
NAVIGATION	
The U. S. is working on a navigation satellite of high degree of refinement.	It is not known whether the USSR is devoting effort to a navigation satellite.

Ehricke Asks Single Space Chief

New York—Responsibility for this country's space effort needs to be placed in the hands of one man who would have executive authority comparable to that of the President, according to a leading U. S. space scientist.

Speaking at the Wings Club here, Convair's Krafft A. Ehricke also made definite suggestions as to how the U. S. might regain the lead in space technology that now is held by Russia. Ehricke suggested:

• **Concentration** of development effort on a limited number of vehicles in place of the current "shotgun" approach. U. S. space program has suffered in attempting too many things, he claimed.

• **Two most promising** vehicles under development are the Atlas Centaur and the Saturn, according to Ehricke. These, he said, will enable the U. S. to establish manned space stations and carry out lunar reconnaissance. First Centaurs are to be fired in 1962.

• **This country must remain alert** to the Russian lead in space but should not formulate its own space effort on the basis of Russian achievements. Ehricke believes that Russia will try a Mars shot in October, 1960, and a Venus shot in January, 1961.

• **During the next decade,** the primary objective of United States' space exploration should be a carefully planned program of lunar research culminating in a lunar landing of a manned vehicle. Over the same period, this country's primary objectives for space utilization should be the launching of communications, meteorological, astronomical and navigation satellites. Also in this time interval but on a lower priority budget, the U. S. should continue its launching of deep space probes.

• **Next step in powerplant work** should be the development of large liquid hydrogen-liquid oxygen boosters with 200,000 to 250,000-lb. thrusts which could be used, in combinations of two and three to launch a large nuclear rocket engine of 200,000-lb. thrust.

Ehricke was asked the reasons for the delay in Atlas boosters for the Atlas-Able space vehicles. The problem he said, was not in the production end; Convair can make as many Atlases as required by all U. S. programs. Once the National Aeronautics and Space Administration requisitions Ballistic Missiles Division for an Atlas booster, it takes approximately ½-¾ of a year for delivery. NASA, however, usually wants the boosters on short notice, and to bring a regular Atlas back into the shop for modification is a costly and time-consuming process that also disrupts regular military production.

Moreover, he said, space research is a low priority project now. The military ICBM and Project Mercury programs get first call on vehicles and, more critical, on launching facilities.

ICBM Detection

Indication of how intercontinental ballistic missile detection from space might work was given by Krafft A. Ehricke at the Wings Club luncheon. Plans are under way, he said, to use selected infrared wave lengths in a detector which, in effect, would wash the earth out in grey tones and make visible energy sources that might emanate from the explosion of a nuclear bomb or the launching of an ICBM.

1951 First to fly a shaft turbine helicopter anywhere.

1954 First to fly a helicopter powered by twin turbines.

1956 Kaman flew the first helicopter to be powered with a gas turbine designed specifically for helicopters.

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THE YEARS BEHIND PUT KAMAN YEARS AHEAD IN TURBINES

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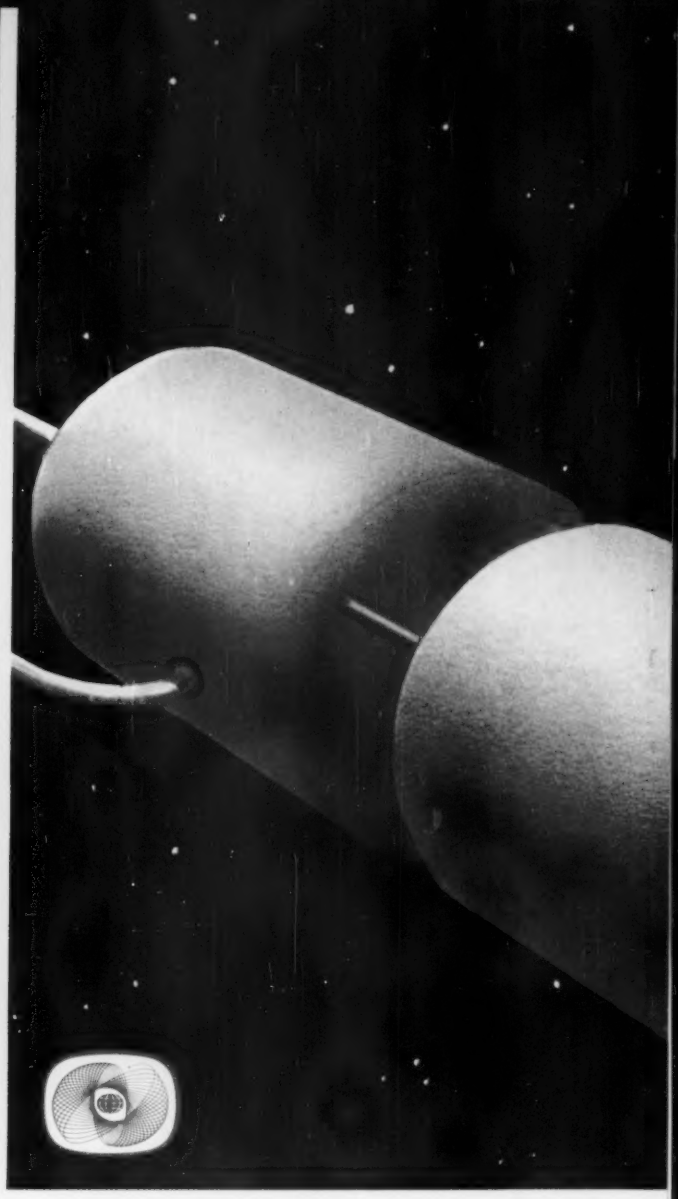

Here is Aldrich Zmeskal, Manager of Balloon Engineering, observing the launching of another General Mills balloon —one of thousands which we and our customers have flown in the past few years. This routine flight was for the purpose of obtaining samples of radioactive material from the stratosphere. Through our balloon research projects, we have amassed a considerable fund of knowledge valuable to future space flight.

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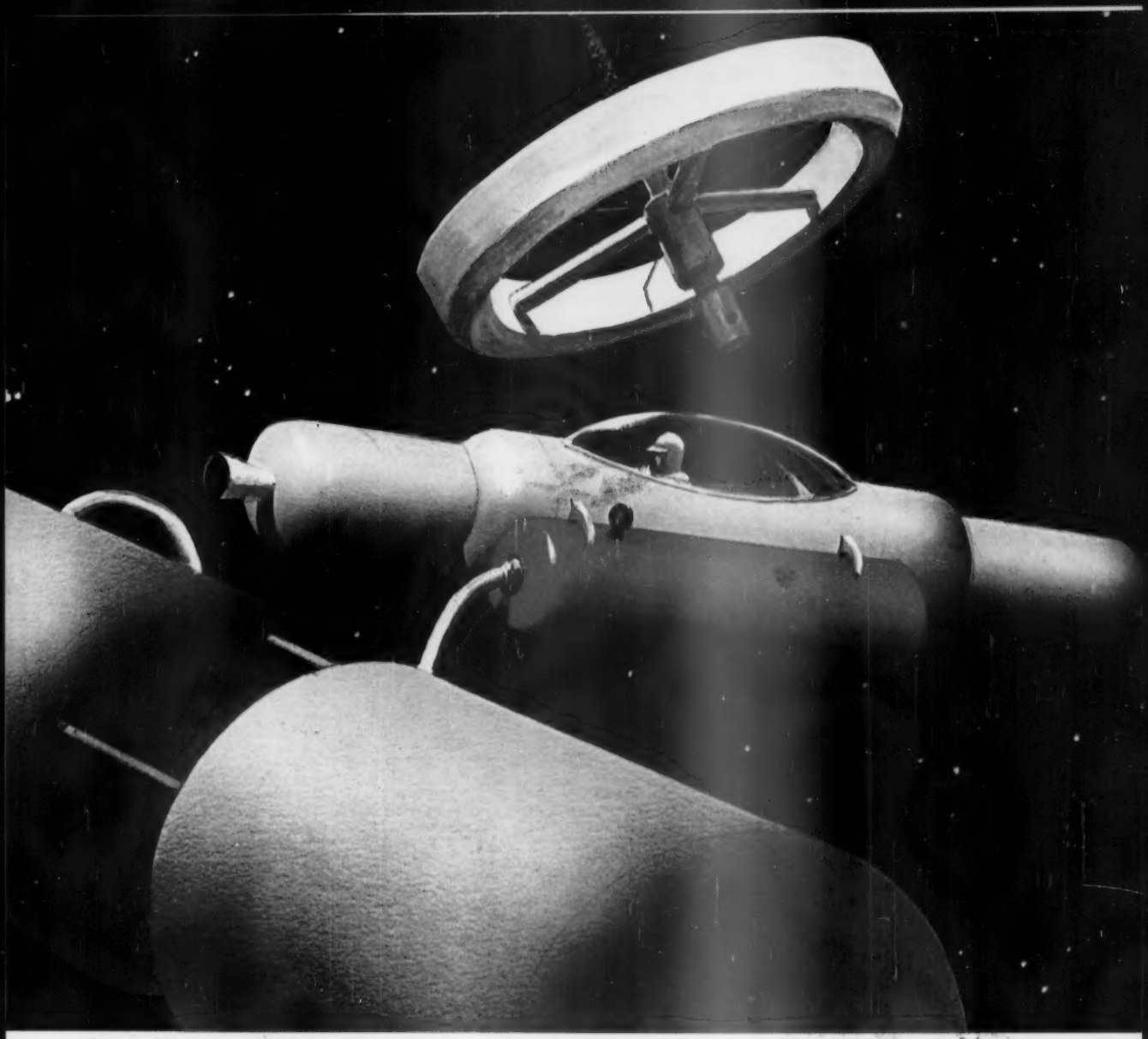
The Mechanical Division provides "floating laboratories," balloons carrying heavy payloads of equipment—and even men—to altitudes above 95% of the earth's atmosphere. This is a relatively easy and inexpensive way to obtain the knowledge which will enable man to travel in space.

Our many research activities cover broad areas in physics, chemistry, mechanics, electronics and mathematics. Some of the studies representative of these activities are: ions in vacuum, deuterium sputtering, dust erosion, magnetic materials, stress measurements, surface friction and phenomena, trajectory data and infrared surveillance.

In our engineering department, current projects include: specialized inflatable vehicles and structures, airborne early warning systems, micro wave radar test equipment, antennas and pedestals, infrared and optics,



Manned vehicle refueling in space . . . illustration from book written for General Mills by Willy Ley.

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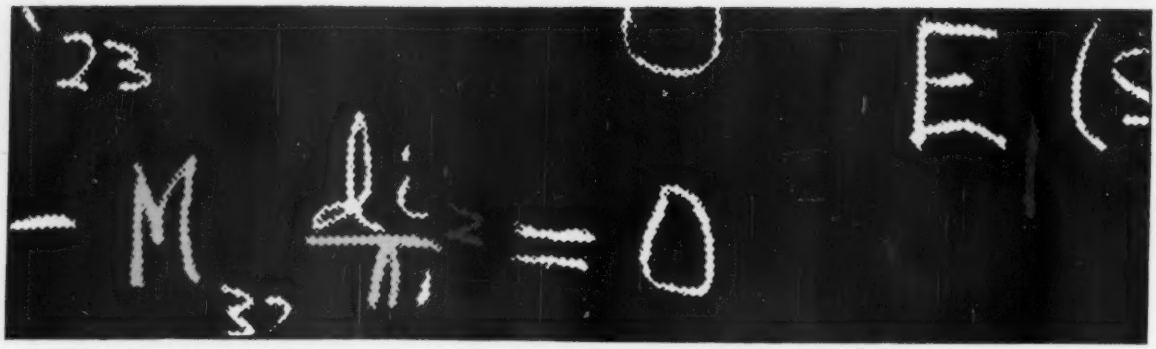

General Motors pledges

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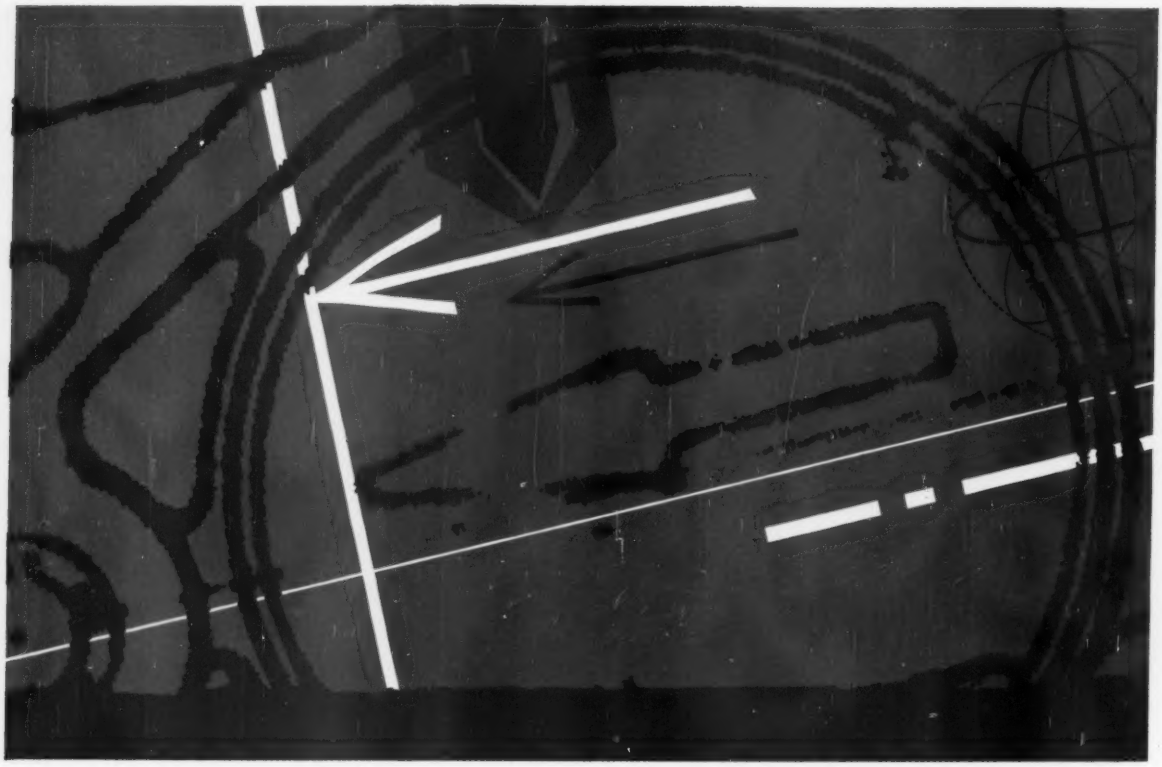

AC Seeks and Solves the Significant—AC Design and Development is moving far ahead in new technology—the result of GM's commitment to make ever larger contributions to the defense establishment. AC plans to resolve problems even more advanced than AChiever inertial guidance for Titan / This is AC QUESTMANSHIP. It's a scientific quest for the development of significant new components and systems . . . to advance AC's many projects in guidance, navigation, control and detection / Dr. James H. Bell, AC's Director of Navigation and Guidance, sees this as a "creative challenge". His group takes new concepts and designs them into producible hardware having performance, reliability and long life. He strongly supports the fact that an AC future offers scientists and engineers "a great opportunity to progress with a successful and aggressive organization" / If you have a B.S., M.S., or Ph.D. in the electronics, scientific, electrical or mechanical fields, plus related experience, you may qualify for our specially selected staff. If you are a "Seeker and Solver", write the Director of Scientific and Professional Employment, Mr. Robert Allen, Oak Creek Plant, Box 746, South Milwaukee, Wisconsin.

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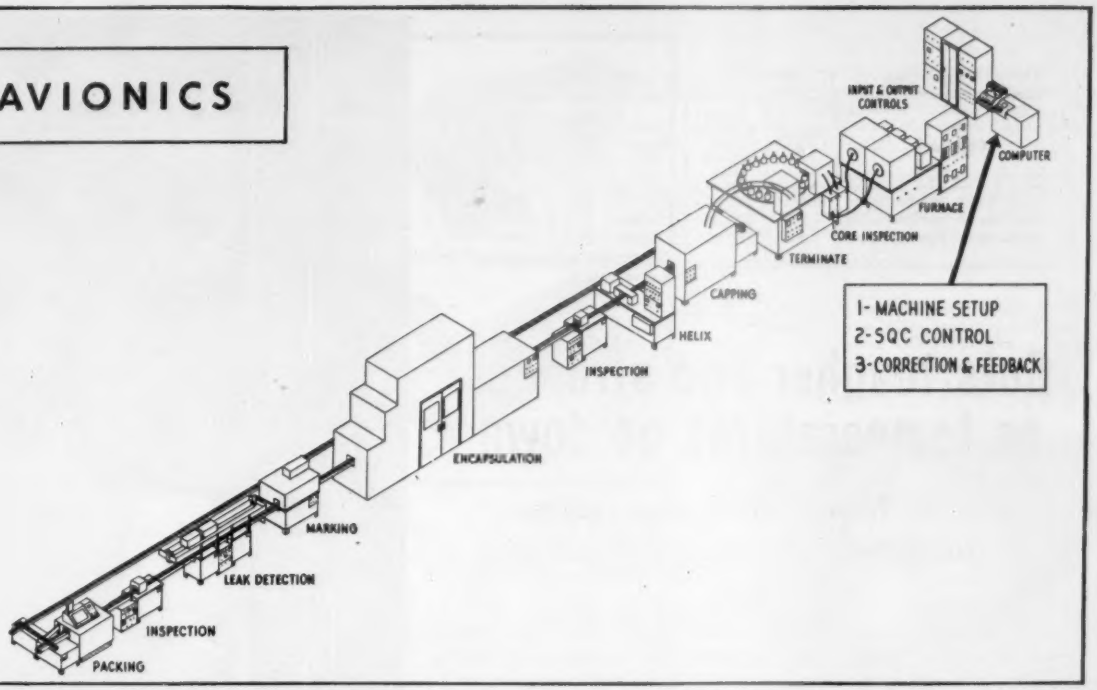

NATION'S first fully-automated facility for producing deposited carbon resistors, using digital computer to program work and to perform statistical quality control, will soon go into operation at Western Electric plant near Winston-Salem, N. C.

Computer Controls Resistor Production

By Philip J. Klass

Winston-Salem, N. C.—The nation's first fully-automated facility for making precision-deposited carbon resistors, with the complete process being continuously monitored and controlled from a central digital computer, will go into operation here shortly at Western Electric.

The fully-automated line will manufacture, inspect, test and pack precision resistors without human operators or intervention at a rate of 1,200 units per hour in ¼- to 2-watt sizes, 2,400 per hour in ⅛-watt sizes. This is equivalent to an annual production rate of 3-6 million resistors per year on a two-shift basis. The computer will not only monitor product quality on a statistical basis but will even control the number of each type resistor produced according to programed needs.

Cost Reduction

The new facility is expected to cut resistor cost by about one third, but its primary objective is to provide the higher quality, ultra-reliable units needed for the Nike Zeus and for the Bell System. Western Electric has spent about $1 million in company funds to date in development of the new facility and in constructing two automated production lines, one to manufacture ¼- to 2-watt resistors, the other for ⅛-watt units.

Resistors produced on a pilot-batch basis in the new facility have already revealed the improved quality which can be expected from automation. When ordinary molded precision carbon film resistors are subjected to a 24-hr. bake test at a temperature of 125C, followed by a 250-hr. moisture test at 100% humidity, they undergo an average change in resistance of 7%, whereas new units produced by Western Electric experience only a 0.3% change, company officials report.

If Defense Department authorizes preproduction tooling and effort on the Nike Zeus program, it is expected that three or four companies will share in the production of the tens of millions of resistors needed for Zeus. Under these circumstances, Western Electric will negotiate with other producers for the use of identical automated facilities to assure uniformity and interchangeability of all producers' resistors. This is similar to the company's policy on the 2N559 mesa transistors used in the Zeus (AW Nov. 30, p. 74).

For the Zeus application, resistors are required to have a failure rate of no more than one failure per billion component hours of usage.

Perhaps the most interesting aspect of the Western Electric program is the use of a central digital computer to control the number of resistors of each type produced, in accordance with programed needs, and to perform statistical quality control analysis on a "real-time" basis as the units are being fabricated.

Inspections at critical stages of the process are performed automatically and the results fed back to the computer instantly for analysis so the computer can alter any portions of the process as required to maintain desired product uniformity and/or quality.

Redesign for Automation

When Western Electric started the project over two years ago, its primary objective was to improve product quality and reliability with automation as a means to this end, rather than an end in itself, according to J. D. Schiller. Schiller, who spearheaded the team of engineers that developed the new facility, is assistant superintendent of manufacturing development engineering for the company in Winston-Salem.

The deposited film resistor basically is not a complicated device. It consists of a thin film of pure crystalline carbon, deposited on a short ceramic rod. After deposition, the carbon-coated rod has a spiral path cut along its length, like the thread on a screw. The pitch of the spiral cut determines the effec-

Some Properties of "K" Monel alloy at Low Temperatures

Condition	Temp. °F.	Yield Strength 0.2% Offset psi.	Tensile Strength psi.	Elongation % in 2 in.	Reduction in Area %
Cold-drawn, age-hardened	Room*	120,000	160,000	20.0	35.0
Cold-drawn, age-hardened	−110	134,600	171,550	17.3	41.1
Cold-drawn, age-hardened	−300	160,200	202,000	27.0	47.3

*Nominal values

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For information on low-temperature properties of these standard production alloys, send for "Some Properties of Huntington Alloys at Low Temperatures." Ask about the new high-temperature alloys, too . . . if that's where your special interest lies.

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"K" MONEL®

WESTERN ELECTRIC'S automated facility will produce five sizes of encapsulated precision deposited film resistors ranging from ¼- to 2-watt rating.

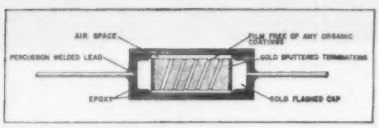
tive carbon path length, hence its overall resistance. The leads are then attached to the rod and it is mounted in a suitable enclosure.

Despite the device's inherent simplicity, there are many potential pitfalls in its manufacture which can result in poor quality and/or short life. If any organic material comes into contact with the thin film during manufacture, it can result in a change in the resistance value in subsequent use and/or short life, according to Schiller.

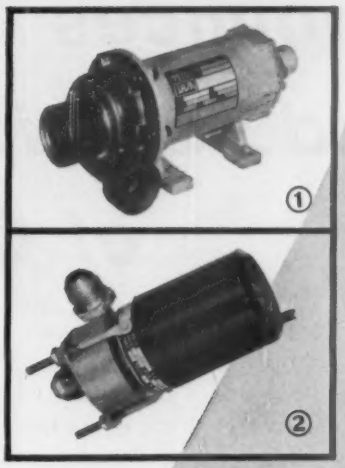
Contamination Factor

There are many opportunities for such contamination in a non-automated process of manufacture, according to Schiller. For example, carbon film formerly was deposited by tumbling ceramic rods in a furnace where methane gas is heated until it decomposes to provide crystalline carbon. Imprecise control of the deposition process and spiraling usually requires an operator to manually rub down each unit to achieve the desired resistance. If thin spots develop in portions of the film as a result of the rubdown, this causes hot spots and short life.

Western Electric engineers concluded that precise control with feedback during deposition of the carbon film and subsequent spiraling could eliminate the need for manual trimming operations and the resultant possibility of contamination. For similar reasons, Western Electric decided to employ an in-line production line with the units being transported automati-



DEPOSITED FILM resistor was redesigned to facilitate automation and to improve quality and reliability for use in Nike Zeus anti-intercontinental ballistic missile.



1 Dielectric-Coolant Pump, Model 3631: For liquid cooling systems. Fluid-cooled 5 HP continuous duty motor. Weight, 7.5 lbs. 400 cycles. 115/200 volts. Pump pressure rise: 88 PSI at 53 GPM.

2 Water System Central Pressure Source: For aircraft drinking-water systems. Available with overheat protector switch. .14 HP continuous duty motor. Weight, 1 lb. 400 cycles. 115/200 volts. Can run dry. Pump pressure rise: 25 PSI at 5 GPM.

3 Dielectric-Coolant Pump, Model 3971: For liquid cooling of electronic instrumentation. Fluid-cooled .15 HP continuous duty motor. Carbon bearings. Can run dry. Weight: 21 ozs. 400 cycles. 115/200 volts. Pump pressure rise: 20 PSI at 3½ GPM.

centrifugal, axial, conical, mixed flow

TASK hydrodynamic pumps

featuring dry or integral fluid-cooled motors

Task's special motor design concepts, combined with advanced pump techniques have resulted in a line of light weight, high efficiency pumps for fuels, lubricants, dielectrics, coolants and potables.

Unique internal construction permits operation of integral fluid-cooled motors without viscous losses* normally associated with the motor rotor. Wet motor construction obviates the use of rotating seals and attendant leakage problems.

Most models available from stock. We invite your inquiries on special requirements. Write for further information, or phone PRospect 4-3100.

*Pat. Pend.

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Holley Announces A Nationwide Service Network of Commercial

Service or replacement of Holley's compressor bleed governors, bleed pistons and bleed valve actuators is now immediately available throughout the U.S.

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CONTINENTAL AIRLINES

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for Efficient Servicing Jet Airliners

In 14 key areas throughout the U. S., there is now a competent Holley service shop readily accessible to airlines flying the Boeing 707 or Douglas DC-8. These service outlets are fully equipped and stocked branches or main service departments of three well-known aviation parts and service distributors: Pacific Airmotive, Southwest Airmotive, and Airwork.

Each of these distributors has personnel specially trained in the servicing of Holley aircraft products and each maintains a stock of both assembled units and components of Holley compressor bleed governors and actuators. Replacement or service of these jet engine accessories is literally only minutes away from any metropolitan center.

If you would like a complete brochure of Holley products, facilities, and service outlets, simply address the Aircraft Division at Holley.

West Coast and other Western states airlines and commercial customers are serviced through the several branches of the Pacific Airmotive Corporation and its subsidiaries

The handsome new facilities of the Southwest Airmotive Corporation at Love Field, Dallas, Texas, are headquarters for Holley sales and service for Dallas and other south Texas areas.

East Coast and Southeastern sales and service are provided through the organization of the Airwork Corporation and its several branch locations.

HOLLEY Carburetor Co.

A-28 11955 E. NINE MILE ROAD
WARREN, MICHIGAN

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At last... a standard gate valve that can be adapted quickly to any fuel or hydraulic system! After years of manufacturing over 1,000,000 gate valves, WHITTAKER CONTROLS now presents a complete line of standard gate valves incorporating the finest time-proven features. Whittaker pioneered and developed the much imitated concept of the one-piece mechanically loaded and retained Teflon dynamic seals. This allows satisfactory operation under the most demanding fluid characteristics and environmental conditions. Whatever your requirements in fluid controls, Whittaker can provide the answer. Note these features: • interchangeable actuators—can be detached without removing valve from plumbing • low-torque manual override • rugged construction—corrosion resistant, wearproof, insensitive to temperature change • thorough qualification testing—meets or surpasses all requirements of MIL-V-8608 • withstands up to 40-g vibration over a wide spectrum of frequencies • immediate delivery—pre-engineered for all applications. Write for brochure or call any of our offices for information.

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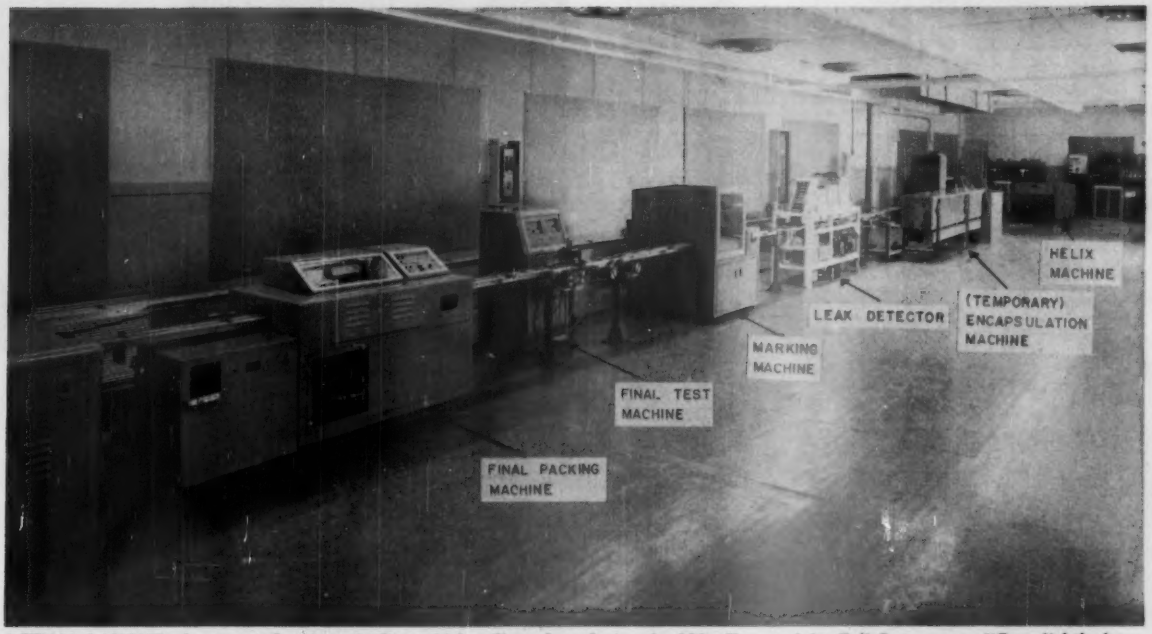


ACTUAL LAYOUT of automated resistor facility, which will produce devices for Nike Zeus and for Bell System use, differs slightly from sketch in that line is "bent" at a 90-deg. angle and the leak detector is moved ahead of the automatic marking machine.

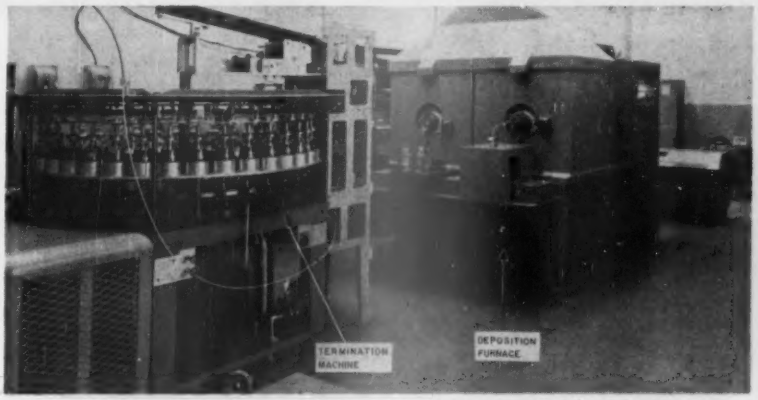
cally in tubes or pallets between individual machines on the line.

Company engineers incorporated a number of new design features to improve reliability, performance and to ease the task of automation. For example, instead of rolling on silver paint at each end of the film, followed by a long baking process, to provide a means of electrical connection, the new design employs thin gold films which are quickly sputtered on in a vacuum chamber. Gold-plated end-caps to which leads have been attached by percussion welding replace the old tin-plated end-caps to improve contact reliability. These changes have reduced contact noise by a factor of 4:1.

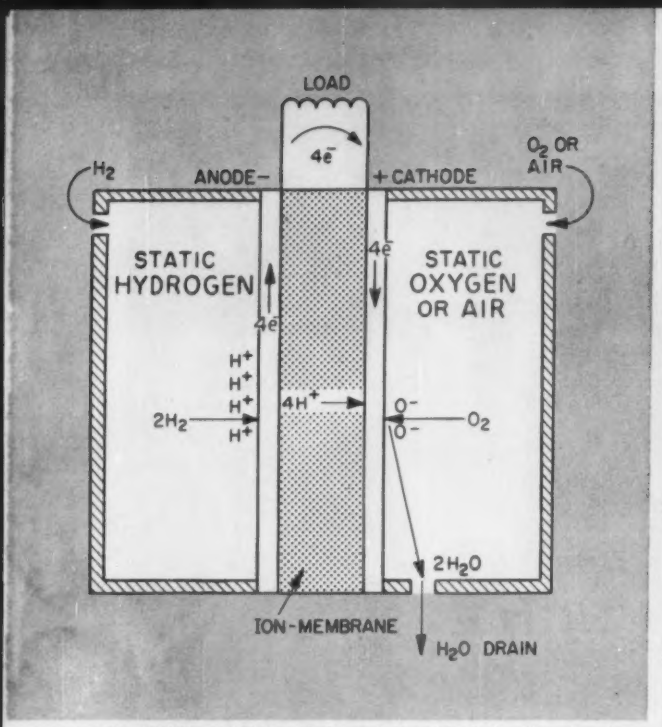
First step in the new Western Electric automated line is the deposition of the carbon film on individual ceramic rods, or cores as they are called. The central computer controls furnace temperature, the flow of methane gas and the rate at which the cores pass through the furnace, which determines the thickness of the deposited film and hence the resistance. With computer control, the resistance of the core can be controlled to within 2% instead of the former 25%, eliminating the need for sorting before the advent of spiraling operation.

The cores are then transported to an inspection machine which checks resistance of deposited film and feeds the results to the central computer. If the cores show a significant shift from the desired value, the computer automatically adjusts the operating parameters of the deposition furnace.

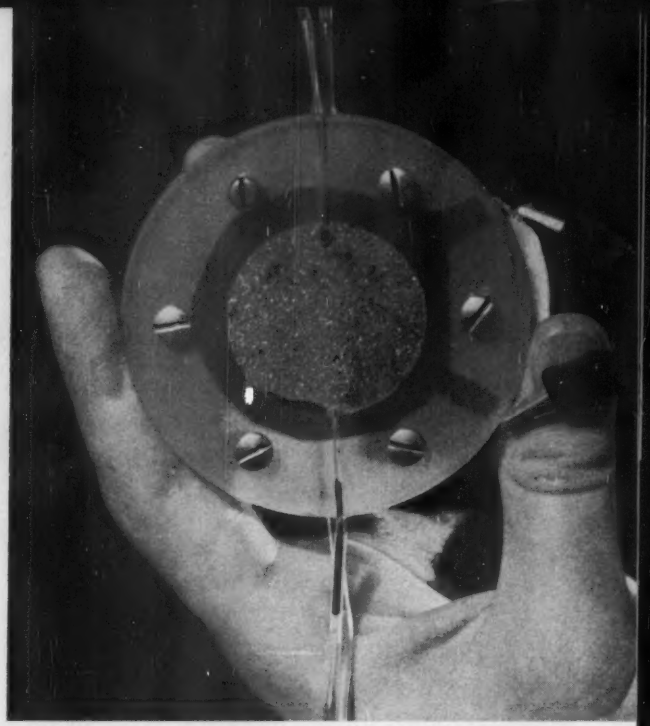
The next step in the process in the



LGP-30 digital computer (below, right) controls the entire resistor manufacturing process including work scheduling, machine changeover and statistical quality control. Termination machine and deposition furnace are shown above.



OPERATING PRINCIPLE of General Electric's fuel cell is based on hydrogen-oxygen reaction that releases useful energy . . . electricity. Schematic cross-section shows relationship and function of the two



electrodes and solid ion-membrane electrolyte. Simple, compact and rugged, a single fuel cell is only one-quarter inch thick. They can be stacked in series or parallel to form fuel cell "batteries."

Story of General Electric's Ion-membrane Fuel Cell

IT'S SIMPLE, RELIABLE AND EFFICIENT!

The quarter-inch thick wafer you see above is one of General Electric's new ion-membrane fuel cells. It is silent. It has no liquid electrolyte. It has high fuel efficiency. We'd like to tell you about it; but before we do, let's start at the beginning. . .

WHAT ARE FUEL CELLS?

A fuel cell is an electrochemical device in which energy, derived from a chemical reaction maintained by the continuous supply of chemical reactants, is converted directly to electricity. This means that, like a common battery, a fuel cell converts chemical to electrical energy. But, the fuel cell has two major differences:

(1) The fuel is obtained from outside the cell, and only as needed to meet load demands. *It is not stored within the cell.*

(2) The products of the reaction are dissipated and the cell, therefore, remains invariant. That is, *no change takes place* in the electrodes and the membrane-electrolyte.

Most low-temperature fuel cells are based on a hydrogen-oxygen reaction. Our ion-membrane cell operates on this principle . . . but with a difference. It is self-regulating . . . no external controls are required.

GENERAL ELECTRIC'S FUEL CELL

Hydrogen and oxygen (or air) are supplied to opposite sides of the cell and are separated by a solid plastic membrane. Hydrogen ionizes at the anode, forming ions that enter the membrane-electrolyte. The ions migrate through the membrane to the oxygen electrode. Simultaneously, electrons travel the external circuit to the cathode where they reduce the oxygen. Over-all result: the controlled chemical combining of hydrogen and oxygen to form water, and the release of useful electrical energy.

WHAT IT WILL DO

Open circuit voltages as high as 1.08 have been obtained. Large prototype cells have produced 42.5 amps per square foot (800w/ft^2) when generating maximum power. Thermal efficiency under typical load is about 60 percent, and improves under light loads. Demonstrator cells (like the one shown above) have been operated for extended periods on an experimental basis . . . one around the clock for more than 300 days.

General Electric's cell is safe, compact, rugged. It is also reversible. That is, it can be used to electrolyze water, producing hydrogen and oxygen. Thus, it can also be used to store energy . . . from a solar generator, for example.

There is no limit to fuel cell size, or the applications for it. Right now, we are producing limited quantities of practical-sized cells daily. We are also developing prototype hardware . . . a portable power pack for the U. S. Marine Corps that will put out 200 watts of 22-28 volts d-c. An expendable hydrogen generator weighing about 5 lbs provides 14-hour operation.

If you would like to know more about G-E fuel cells, write for a free booklet.

General Electric Company, Section A231-32, Schenectady 5, N. Y.

Yes, please send me "Some Plain Talk About Fuel Cells" (GED-7041).

For immediate project ☐

For reference ☐

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GENERAL ELECTRIC

deposition of the gold terminations at both ends of the core by a vacuum sputtering process. Because of different size cores used in the different wattage resistors, a different size mask is required for each size. This is automatically selected by instructions from the central computer.

The leads are percussion-welded to the gold-plated end-cap in the one operation which is off-line. Machine automatically selects proper size wire and end-cap, under computer instructions, straightens its leads and attaches it to the end-cap. End-caps are then transported to the automated line and installed at both ends of the core in the capping machine.

Spiraling Process

The core next goes to the helix machine where it is picked up by vacuum and placed in the spiraling chuck. A diamond wheel is used to cut the spiral, with the pitch automatically controlled by the central computer to produce the desired resistance. A built-in Wheatstone bridge continuously measures the resistance during the spiraling operation, stops the operation when the desired value of resistance is achieved. During this operation, the rate at which the resistance increases is electronically monitored for any non-linearity which indicates a non-uniform film, ragged helix or core defect. Such units are automatically rejected. The machine automatically compensates for the increase in resistance that results from the heat of the diamond grinding wheel.

Once again the unit goes to an inspection machine where its resistance is precisely measured and the results are fed back to the central computer.

The next step is encapsulation. Two epoxy pellets are automatically inserted on each lead, brought into contact with the end-cap. An epoxy sleeve is then slipped over the core after which heat and pressure are applied to produce a seal between the end pellets and the body sleeve.

The next step is leak detection. The resistors are immersed in a hot water bath containing glycerine solution to help in the wetting process for about 30 sec. In the former manual production process, girls peered intently at the resistors looking for minute air bubbles which indicate an incomplete seal. Western Electric has equipped its machine with a series of photoelectric sensors which can detect air bubbles as small as 0.010 in. in diameter.

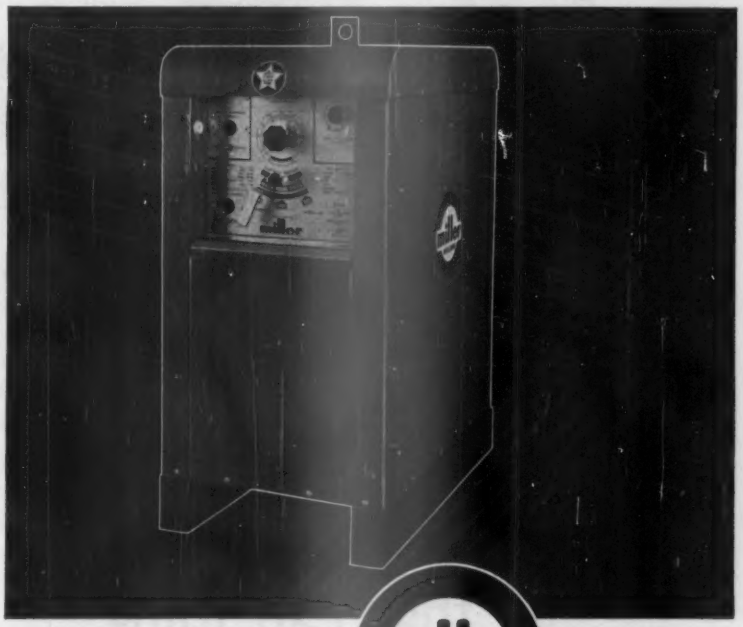
Resistors that pass the leak test go to a marking machine, controlled by the computer, which stamps on the type (wattage), resistance value and production lot code number. Following this, each resistor undergoes final test and inspection in another machine which feeds the results of its tests back to the computer and automatically discards rejects. From this machine the resistors go to a packing machine which pushes their end leads into a block of polystyrene foam which serves as a support for shipping.

Western Electric is using an LGP-30 digital computer, built by Librascope (marketed by Roval-McBee), as its central controller. Schiller says the LGP-30 has proven very reliable.

As much as a month's production needs, prepared on punched tape, can be entered in random fashion into the computer which then automatically programs production according to wattage and resistance, with low-value resistance units being manufactured first.

The computer automatically programs additional cores to provide for expected rejects in order to end up with the required number of resistors. If, however, it finds that rejects are running higher than anticipated, it automatically increases the number of cores released to the furnace in order to compensate for the actual rejects.

Three different diameter cores are used, one for the ⅛-watt size, another for the ¼- and ½-watt resistors and a third for the 1- and 2-watt resistors. The core used for the ¼-watt resistor is slightly shorter than that for the ½-



the economy of miller quality

. . . . becomes evident after sufficient exposure to the original cost/maintenance costs/production/profits equation.

Exploiting the full potential of better basic design, the Miller Gold Star 300 series ac-dc welders convert in minutes from the prime ac-dc welder of exceptional performance to any of these three A-C applications: Metallic Arc, manual or automatic Inert Gas; or, to any of the following D-C applications: Metallic Arc, manual or automatic Inert Gas, or Inert Gas spot welding.

It's important to note that the Miller conversion kits utilized to obtain any of the above simply extend the built-in superiority of the 300 series' welding characteristics into the type of application desired. It's adaptable by design — not discovery.

Available in 200, 300, 400 and 600 ampere models, all feature the exclusive Miller transformers and semi-metallic rectifiers. Complete specifications, including duty cycle chart, will be sent promptly upon request.

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FOUND:

an intellect that can think anywhere

The systems of tomorrow will require digital computers that can think *anywhere*—intellects that will remain superior in any environment.

ARMA—already producing inertial guidance systems for the ATLAS ICBM—has accepted the challenge and developed a lightweight, second-generation digital computer applicable to *all* types of navigation. It can be used in space, atmospheric, surface, subsurface and ground navigation, making possible programming flexibility.

This all-solid state computer, with *no moving parts* and using silicon semiconductors exclusively, has a memory that is non-volatile and has non-destructive readout. And this computer has substantially fewer parts than ARMA's first-generation production model, which has a test performance unequalled by any other digital computer.

An even more sophisticated third-generation computer, surpassing the reliability of the first two with still less weight, will be produced in the future by ARMA. The reliability of all three generations will be assured by thorough testing in ARMA's environmental facilities—the most complete in the industry.

ARMA, Garden City, N. Y., a division of American Bosch Arma Corp. . . . the future is our business.

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AMERICAN BOSCH ARMA CORPORATION

7265-B

watt unit, and the 1-watt resistor core is shorter than that of the 2-watt unit.

For those machines which must change over to accommodate the different core diameter or length at the end of one batch and the beginning of another, a magnetic pellet is inserted in the conveyor tube between the batches to signal the changeover point.

Average changeover time is about three seconds for all the machines except the deposition furnace. In the furnace a longer time is required because the temperature and gas flow must reach equilibrium conditions. Until this is accomplished, a changeover from one wattage to another may cause the loss of as many as 50 cores. However, at this stage in the process the cores are relatively inexpensive, Schiller points out.

Western Electric has designed each machine to be a self-contained operating unit complete with automatic controls to permit it to operate independently in the event the computer becomes inoperative or it is desired to operate without the computer. Under such circumstances, human supervisors would exercise the production programming and quality control functions.

Motorola to Acquire LearCal Division

Santa Monica, Calif.—Lear will sell its LearCal Division, maker of communication, navigation and flight control systems for general aviation aircraft, to Motorola, Inc., in exchange for Motorola stock if agreement can be reached on an exchange price. Approximately 20,000 to 30,000 shares of Motorola stock are expected to be involved.

Transfer is expected to take place in January, with LearCal becoming Motorola Aviation Electronics, Inc., a wholly owned subsidiary. Kenneth M. Miller will remain as manager of the operation. Motorola says it will move the new subsidiary to another facility in or near Santa Monica as soon as the transfer proves feasible. Previous negotiations between two companies had fallen through because Motorola reportedly wanted to move the operation to its Chicago facilities.

The LearCal Division, which employs approximately 400 people, including 50 engineers, accounts for about $8 million sales, or about 9% of Lear's anticipated 1959 total. Balance of Lear's business is in flight controls, instruments and accessories.

Although the LearCal Division had not been as profitable as Lear's other divisions in recent years, the move comes as a surprise to many because of the personal interest in general aviation avionics by William P. Lear, board chairman and principal stockholder.

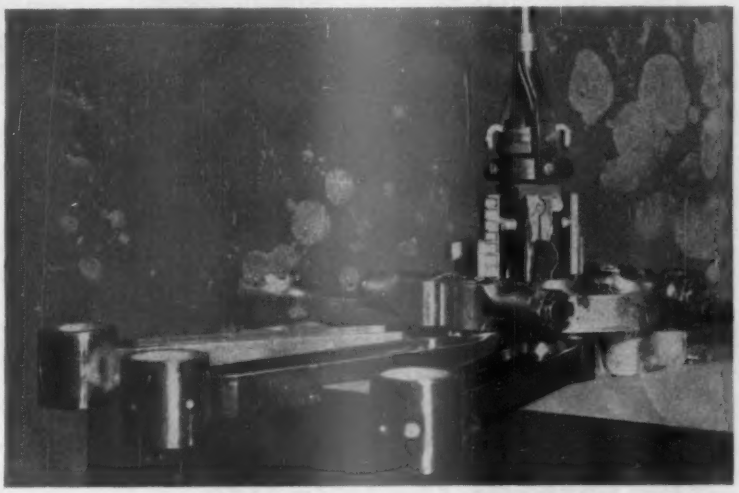
Avionics Installations Gaining in Lightplanes

Washington—Avionic equipment carried by general aviation aircraft, particularly single-engine types seating three or more persons, has shown a sharp increase over the past four years, according to a Federal Aviation Agency survey just released.

An FAA survey discloses that 39% of the nation's single-engine aircraft were equipped with omnirange (VOR) receivers on Jan. 1, 1958, as compared with 19% in 1954. Approximately 58% of the nation's 60,650 single-engine aircraft carried two-way radio equipment as compared with 46% in 1954.

FAA figures show that 93% of the country's 5,370 multi-engine general aviation aircraft were outfitted with VOR navigation receivers in 1958 as compared with 72% in 1954. Approximately 97% of these aircraft carried two-way radio equipment (transmitter and receiver) in 1958, compared with 91% in 1954.

The survey shows that 33% of the single-engine aircraft have no radio equipment, while 9% have a radio receiver only. In 1954, 39% had no radio equipment while 14% had radio receivers only. In the interval, some of



Taking The Stress Out Of A Master Rod

A properly fitted link pin sets up enough internal stress in the master rod bores to bulge the crank shaft bearing area very slightly. These bulges are so small they are almost impossible to detect. But they sometimes set up enough stress to crack the master rod bore during the engine's operating cycle. Master rods are expensive to replace.

This simple Airwork "extra" sharply reduces the danger of bore cracking. After the link pins are in place, Airwork uses an electric hone to eliminate the tiny internal bulges created by pin pressure. Then we make sure the bearing area is perfectly circular after the pins are in place.

It takes only a few extra minutes to hone a pre-assembled master rod to perfect roundness . . . but it adds a lot to the satisfaction you get from a smooth running, long lived Airwork overhauled engine. Airwork saves you time and trouble by doing more work at overhaul, *when it can be done at low cost* and no inconvenience to you. Give your engine an Airwork overhaul—and be sure of maximum operating satisfaction.

Airwork CORPORATION
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Versatile Ground Support for Jet Transport Fleets

8,500 AiResearch Gas Turbine Units in Use

Extremely reliable and diversified, AiResearch mobile ground support equipment provides main engine starting for turbine-powered aircraft, and ground air conditioning and electrical power for both aircraft and missiles.

Heart of the lightweight ground support systems are AiResearch gas turbine compressors which provide pneumatic and/or electrical power. Electrical power is supplied when the unit is coupled with an alternator.

GROUND POWER FLYAWAY UNITS for jet engine starting are designed to meet the need for a mobile low cost pneumatic power source which is readily air portable for emergency use. These lightweight, self-contained units are mounted on a compact cart complete with instrument panel and enclosure. They can also be used for missile ground support where pneumatic power is required.

GROUND POWER VEHICLES supply both pneumatic and electrical power for jet engine starting, ground air conditioning and other ground requirements where these types of power are needed. Air and electrical connections located at the front of the vehicle allow the operator to drive frontward into position. The instrument and control panel are inside the cab, and the power unit is easily accessible through wide doors on both sides of the vehicle. Full sound attenuation reduces operating sound level below 90 decibels at a distance of 10 feet.

GROUND POWER TRAILERS provide pneumatic power for jet engine starting on ground air conditioning . . . and electrical power when equipped with an alternator. These rugged, completely self-contained units are also fully sound attenuated. Servicing is easily accomplished through ample access doors.

AiResearch ground support equipment can be designed to meet specific requirements or installed on standard vehicles. Your inquiries are invited.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Systems, Packages and Components for: AIRCRAFT, MISSILE, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

the aircraft with receivers only appear to have added transmitters to achieve two-way capability.

Analysis of the single-engine aircraft avionic equipment shows that 87% of those that can carry three passengers or more are outfitted with two-way radio equipment, approaching the figure for multi-engine aircraft, while only 32% of the single- and two-place aircraft are so equipped.

Similarly, 71% of the three-place or more single-engine aircraft were outfitted with VOR navigation receivers as compared with only 10% for single- and two-place aircraft. In 1954, only 44% of this type aircraft were equipped with VOR.

The survey indicates that 70% of the multi-engine aircraft carried instrument approach (ILS) equipment in 1958 as compared with 50% in 1954. In the single-engine aircraft category, 4½% carried ILS equipment in 1958, more than double the 2% so equipped in 1954. In the three-or-more-place single-engine category, 9% of the aircraft are equipped with ILS as compared with 5% in 1954.

In the multi-engine aircraft category, 90% carried automatic direction finders in 1958 as compared with 86% in 1954. In the single-engine category, 14½% were equipped with ADF in 1958 as compared with 8% in 1954.

The FAA report contains additional details on types of receivers and transmitters carried, number of channels available and related data. Copy of the report, entitled "General Aviation Aircraft Radio Equipment, 1958," can be had from Government Printing Office, Washington 25, D.C. at a cost of 20 cents per copy.

FILTER CENTER

▶ **Raytheon Wins Polaris Award**—Competition to select a contractor to build an advanced Polaris guidance computer and associated control systems using newly developed welded-module construction has been won by Raytheon. The company is one of the pioneers in the welded-module construction technique (AW Aug. 24, p. 104). Raytheon will build to a basic design developed by Massachusetts Institute of Technology's Instrumentation Laboratory.

▶ **Hot New Semiconductor**—Army Signal Corps has constructed a diode out of gallium phosphide that can withstand temperatures of up to 1,500F. Army Signal Research and Development Laboratory at Ft. Monmouth reports that it is continuing its studies of basic material properties before launching a device development program.

PROTECTION AGAINST IN-FLIGHT FAILURE

LISLE *Magnetic* CHIP DETECTORS

Lisle Magnetic Chip Detectors provide a constant warning system against in-flight failures when connected to a light on the Flight Engineer's or Pilot's instrument panel.

Presence of ferrous particles in the lubricant is a proven indicator of internal breakdowns. The powerful magnet in the Chip Detector picks up these particles as they appear. The particles bridge an electrically insulated gap in the Chip Detector and complete a circuit which activates the warning light.

As an alternative to a permanently wired system, Chip Detectors can be ground checked with a continuity tester.

Write for complete engineering information and test samples

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Report Urges Accelerated Missile Effort

By Katherine Johnsen

Washington—Advisory report to the Senate Foreign Relations Committee has urged "a most strenuous effort" to accelerate development of the Air Force's Minuteman solid-propellant intercontinental ballistic missile in an effort to close the Soviet missile gap by the mid-1960s.

The report on the impact of military technology on strategy and foreign policy was prepared by Johns Hopkins University's Washington Center of Foreign Policy Research under contract with the committee, which is headed by Sen. William Fulbright (D.-Ark.), as one of 15 major studies on foreign policy that have been ordered by the group.

"Indeed the most discouraging aspect of the missile gap," the report said, "is that we seem unable to escape it should the Soviets produce the number of ICBMs of which they are believed capable." Estimating that the U.S. will have an inventory of slightly more than 100 operational intercontinental ballistic missiles by the end of 1962 under the present program, the report added:

"With even a crash program of base construction, it is difficult to imagine how the U.S. force could be increased to more than 300 missiles by 1963—in comparison to a possible Soviet inventory of 1,000 or even more."

The report cautioned, however, that "this Soviet capability and intention may of course turn out to be as greatly exaggerated as those estimates of Russian bomber production given Congress but three years ago" by Gen. Curtis LeMay, then commander of Strategic Air Command and now vice chief of the Air Force.

The report said that the present Soviet program "appears" to be to create "only a counter-deterrent force" but that the U.S. "can ill afford to rely on such a reassuring estimate of Soviet intention."

Strategic Air Command was largely discounted as inadequate for both retaliatory strikes and first-blow attacks designed to cripple the Soviet ICBM force. The report said:

"Once missiles are introduced, the importance of the Soviet intelligence advantage assumes almost staggering proportions at a time when U.S. strategic power remains centered in a manned bomber force. While the Strategic Air Command might now receive no warning whatsoever of a missile attack, and may never get more than the 15 to 20 min. warning that sophisticated radars may provide, there is even less chance that a majority of the Soviet missile bases can be located in advance of a war. It thus becomes exceedingly doubtful that the Soviet missile force could be effectively attacked by an American first strike. . . .

"As if to increase this Soviet advantage, the locations of U.S. missile sites, radar-warning installations, air-defense facilities, and naval communications centers are being widely publicized long before they are even built."

The small number of Navy Polaris fleet ballistic missiles that could be made available by 1962-63 means that this force cannot be considered as a significant deterrent during the missile gap period, the report said. It also noted "the anticipated low order of accuracy and destructive power of the Polaris missile relative to liquid fuel ICBMs. . . ."

NATO, 'Minimal'

The report further classed the value of NATO airpower and carrier-launched aircraft as "minimal in view of the vulnerability of these weapons to existing Soviet missile systems. . . ."

"Top priority" was recommended for measures that will reduce the vulnerability of U.S. strategic forces during this missile-gap period, including "the protection of airbases, bombers, control centers, missile launching sites and personnel through increased mobility, concealment, hardening and dispersal."

Noting a tentative USAF program to keep "a small number" of bomb-loaded long-range aircraft on continuous airborne alert as protection against surprise missile attack, (AW Dec. 7, p. 34), the report observed:

"Preliminary tests indicate that 90% of the airborne planes could be kept within range of their targets, but that it would be very difficult to keep even as much as a third of the long-range strategic bomber force on air alert, presumably because of a shortage of trained crews." The cost of the USAF air alert project, in additional fuel and maintenance alone, was estimated at $1.2 billion annually.

The mid-1960 era of dispersed, hidden and mobile solid-propellant ballistic missiles, the report said, should provide a "stalemate" period between the U.S. and the Soviet Union.

It noted:

"A surprise attack on the opposing force will become increasingly hazardous, if not foolhardy, and much of the present incentive to strike first will vanish." The report said Minuteman missiles will be kept in a constant state of checkout, with their guidance gyros running continually, reducing launch time to one to two minutes as compared with the optimum present countdown for liquid-fueled ICBMs of 15 min. The relatively low cost of Minuteman, $1 million to $2 million for "a missile in a hole," as compared with $10 million for current ICBMs, will be offset, the report said, by the large number that will have to be deployed "in compensation for their own limited destructive power and the accuracy of opposing enemy missiles." The desirable force level, the report said, is estimated at from 800 to 2,600 Minuteman missiles.

The report also urged that steps be taken toward disarmament but opposed the "total disarmament" proposal of Premier Nikita Khrushchev. "There is no reason to believe that even the Soviet leaders are merely engaging in duplicity when they express their anxiety about the sources of nuclear instability," it commented.

The report said the Soviets "cannot view lightly the instabilities that stem from a powerful first-strike capability, itself highly vulnerable to a first strike by the enemy. Nor can they easily dismiss the dangers of accidental war. . . . Today they may brandish their rockets, but 'brinkmanship' was not initiated by them and it is not a Soviet monopoly . . . ."

As to the Khrushchev proposal, the report commented: "In a totally disarmed world even a small number of secreted or clandestinely manufactured nuclear weapons could disrupt the international order and allow one power to dominate its more trusting adversaries. It is doubtful that any devisable, much less agreeable, inspection system could disclose such violations with a sufficient degree of certainty. International disputes over vital political and economic issues would, in any event, be likely to lead to the resumption of a hectic arms race and, in the final analysis, military power and technology would still decide the outcome."

The report proposed a system under which each of the major powers would retain a substantial retaliatory force relatively secure from attack.

"Let us assume that such an arms control system permitted each side to maintain 200 or 300 strategic nuclear weapons so hardened, mobile and dispersed that to eliminate any one of them would require a substantial num-

ber of attacking weapons of great destructive power and accuracy. Under such conditions even the surreptitious addition of several hundred weapons to the attack capability of one side or the other would not be sufficient to upset the stability of the system. Any temptation to violate the system would be restrained by the knowledge that a very great effort, indeed an effort so great as to run the high risk of detection, would be required before the inherent stability of the system could be overcome."

This type arms control plan, the report said, would have to be accompanied by commitments to "openness of scientific and technological research." Although the commitments may not be enforceable in detail, "violation, to be effective, would probably have to be on a scale lending itself to detection."

New Weapon Developments

The report made these observations on weapon systems and techniques now being evolved:

• **Advanced nuclear bombs.** "The possibility of doubling or tripling the power of aircraft nuclear bombs to, say, 40 or 60 megatons, has been mentioned, and transportation of a 100-megaton bomb declared feasible with major improvements in powerplants."

• **Delivery range.** "It now seems possible to extend that of aircraft and missiles to global dimensions." USAF has proposed a third ballistic missile family, "Global Range Ballistic Missile," with a range of over 10,000 naut. mi.—sufficient to reach any target from any launch point on earth.

• **Manned aircraft.** Endeavors, such as the now-canceled "controversial" Mach 3 North American F-108 fighter and the severely stretched-out North American B-70 bomber projects (AW Dec. 7, p. 26), "are deemed necessary to enable manned aircraft to continue to perform missions for which missiles are, and may long continue to be, unsatisfactory. These include intelligence acquisition and reconnaissance, long-range air target identification and strike missions requiring a very high order of accuracy in bomb delivery."

• **ICBM refinements.** These are "of greater significance" than improvements in the manned aircraft field, the report said, and include "auxiliary engines or separable drag skirts to alter their trajectories in flight, application of radiation and anti-radar shielding to their warheads, multiple warheads and the use of missile-borne chaff, decoys, and jammers to disrupt defensive radars." Observing that the value of hardened missile sites varies inversely with missile accuracy, the report said that "the missile requisite to the probable destruction of such a target can be reduced from 60 to 14 as the accuracy of a two-megaton missile is refined from three to somewhat less than two miles.

Avco Photographs Atlas Nose Cone Re-Entry

Photograph of Atlas 8-C nose cone re-entering the atmosphere after being fired from Cape Canaveral, Fla. (AW July 27, p. 40) was taken by an Avco Corp. downrange optical monitoring team based at Ascension Island. Nose cone was recovered. Four re-entry streaks visible above wing of a Douglas C-54 transport were made by the nose cone over a 30 sec. period at 9,000 ft. Avco said the three large breaks in exposure are intentional interruptions of 5 sec. duration for data correlation; smaller breaks are timing interruptions. The Atlas flew 6,300 mi.

• **CAMAL nuclear bomber** and Dyna-Soar boost glide vehicle. Neither of these vehicles, the report said, "appears likely to have a decisive effect on the balance of power even if fully realized." It added, however:

"Both concepts would seem admirably designed to extend the utility of manned aircraft, in time and into space respectively, by making them less vulnerable to air defense systems than the present strategic bombers. CAMAL, in particular, might ameliorate certain dangers of the early missile gap period if both aircraft nuclear power and air-launched ballistic missiles can be perfected in time. Both systems could have military utility in the mid-1960s and beyond, when ICBMs have become the dominant strategic weapons—CAMAL could provide an effective supplementary retaliatory system (partially protected from attack by the mobility derived from its long endurance) while Dyna-Soar could conceivably develop reconnaissance capabilities of value.

"One may express skepticism regarding both possibilities; there are few current indications that CAMAL would be much less expensive than an equivalent missile force, and Dyna-Soar seems a marginal competitor with the reconnaissance satellite as an intelligence collector . . ."

• **Missile defense.** The report dismissed the prospect of development of a defense system that would nullify progress in ICBMs and other strategic weapons. "Certainly the (Army) Nike Zeus anti-missile missile system, the only such active missile defense system known to be under development in this country, does not offer such a hope. Its potential appears limited at best to the spot defense of a relatively few vital targets from a relatively primitive missile attack." Proposals for a death ray to repel incoming weapons, the report said, "is a fanciful one for the foreseeable future, as it does not now appear possible to create either an anti-gravity screen or indeed any system providing 100% effectiveness against all the means by which nuclear weapons can be delivered on large targets."

• **Space reconnaissance.** The report said the technical obstacles "appear multiple and restrictive. They include such problems as the penetration of cloud cover, camouflage and darkness, as well as the technical difficulties and delays stemming from the elaborate chain of events by which images are received, recorded, transferred to a

■ If we were tonnage fiends instead of quality minded producers, we would never keep our performance neck so far out on the close-tolerance limb year after year. But "quality" we intend to be . . . and "quality" we will continue to draw . . . into every foot of TMI small diameter tubing we are privileged to provide for the whole range of application—nuclear, medical, chemical, instrumental, ad infinitum!

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storage device, relayed to the earth's surface, reproduced and examined." The utility of the Midas system for detection of missile firings by satellites equipped with infrared sensors "would appear marginal in comparison with the Navy's (ground-based) Project Tepee intercontinental radar system, and other means of detecting missiles early in flight, but an infrared system might prove less prone to spoofing or jamming than radars and should, at the very least, provide some verification of attack warnings obtained from other sources . . . There appears to be little hope of the Midas system, or other satellite-borne missile detectors, becoming operational in time to relieve our strategic bombers of their imminent vulnerability to missile attack."

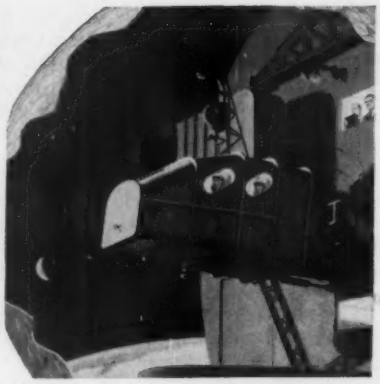
• **Non-strategic weapons.** "U. S. should increase the strength of its non-nuclear capabilities . . . to deter or stop such attacks as the Soviets would dare to launch." The report observed that, as nuclear war becomes increasingly hazardous for an aggressor and the threat of initiating it decreasingly credible, "the employment of localized military force for achievement of national objectives will become increasingly attractive . . ."

Research Administration

In the field of administration of weapon system research, development and production, the report maintained that the decision-making capability of the Soviet dictatorship "is not an unmixed advantage. The difficulty and danger of criticizing official decisions in a dictatorship may lead to less refined and more costly end products, as well as to the production of weapons ill-suited to the support of national strategy."

Commenting that "some radical revisions" also may be necessary to solve the U. S.'s long lead-time problem, the report said:

"Boldness in the acceptance of new ideas and speed in their execution are qualities too often lost. Too frequently, rigidities that ought to be characteristic of the Soviet system are allowed to infect the decentralism that should characterize the American system . . . Yet, the current popular cries to improve R&D through 'czars' and through elimination of 'wasteful duplication' and 'service rivalries' when put into practice frequently lead to excessive administrative supervision, the blocking of new and useful ideas and the fallacy of directing long-range R&D programs toward an impractically specific end product." Instead, as an alternative, the report suggested that "it would be valuable to lessen bureaucratic centralism and to increase duplication of effort at all stages of military research and development . . ."



VOUGHT SEES SPACE WITH A MAN IN IT

At Vought Astronautics, space and manned flight into space are coming steadily nearer.

In the Human Factors Laboratory, engineers and scientists operate earth-orbital simulators and space-capsule mock-ups as complete in cockpit detail as a production aircraft.

Company pilot-engineers have run up a total of more than 200 simulated orbital flights. In other studies, Vought space-medicine specialists are developing closed ecological systems to provide man oxygen, food and water for flights lasting months, years . . . generations.

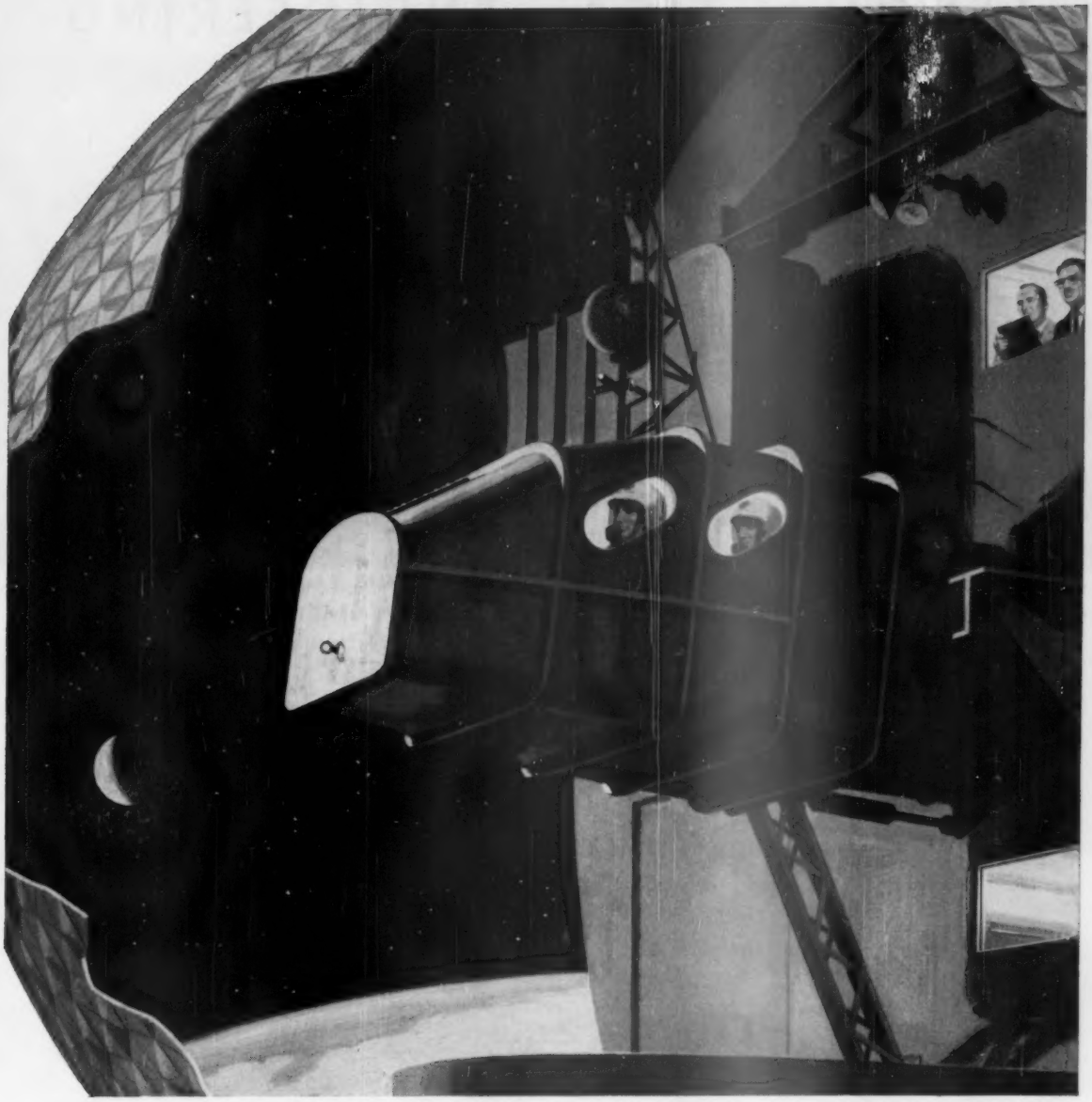
Plainly, Vought Astronautics' interest in space centers around the men who will explore it at first hand, and around the man-carrying portions of their vehicles. This has been a natural step for the life-sciences engineers who gained so much experience on Vought's high-performance aircraft.

Through participation in the *Dyna-Soar* development competition, these men already have applied aircraft human-factors experience to space. In the matter of space-flight and navigation simulation, these men probably are farther ahead than any U. S. team.

A major Vought effort now is to determine which functions of space flight will be machine-operated and which will be entrusted to man. The answer very likely will come out of a simulator — one which duplicates the stresses of space flight.

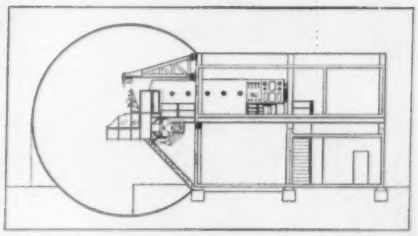
Space is the specialty of Vought Astronautics. Other major interests are being aggressively advanced in the company's Aeronautics Division — where attention is on atmospheric missiles, antisubmarine apparatus and piloted aircraft — and in the Electronics, Range Systems and Research Divisions.

CHANCE VOUGHT
DALLAS, TEXAS



A PLACE TO IRON OUT THE STRESSES OF SPACE

Seventeen different stresses will flay the minds and bodies of the first spacemen. Under the combined attack of acceleration, anxiety, heat and other stresses, how will man perform? The answer probably won't be known until the problem can be simulated, in all of its parameters. Vought Astronautics – a division of Chance Vought Aircraft, Incorporated – is preparing the way with the proposed simulator above. Inside the laboratory's mock space vehicle, a man – without leaving the ground – would know the heat, movement, noise – and many psychological effects – of an extra-terrestrial voyage. He would glimpse a pitching, yawing close-up of the solar system. He would experience, altogether, an invaluable preview of combined stresses of space flight. Vought Astronautics can produce and operate such a lab now for the development of spacecraft and the training of pilots.



From active flight instruments, motion, and a planetarium projection — a realistic preview of space flight.

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CHANCE VOUGHT
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NOSE-HIGH, Mi-4S takes off during hovering tests. Front wheels are fully castering. This latest modified version of the Mi-4 series can carry 16 passengers or an externally-slung load of 2,860 lb. Purchase price is $200,000, including spares and technical assistance.

Soviets Break Into Western Market With

By David A. Anderton

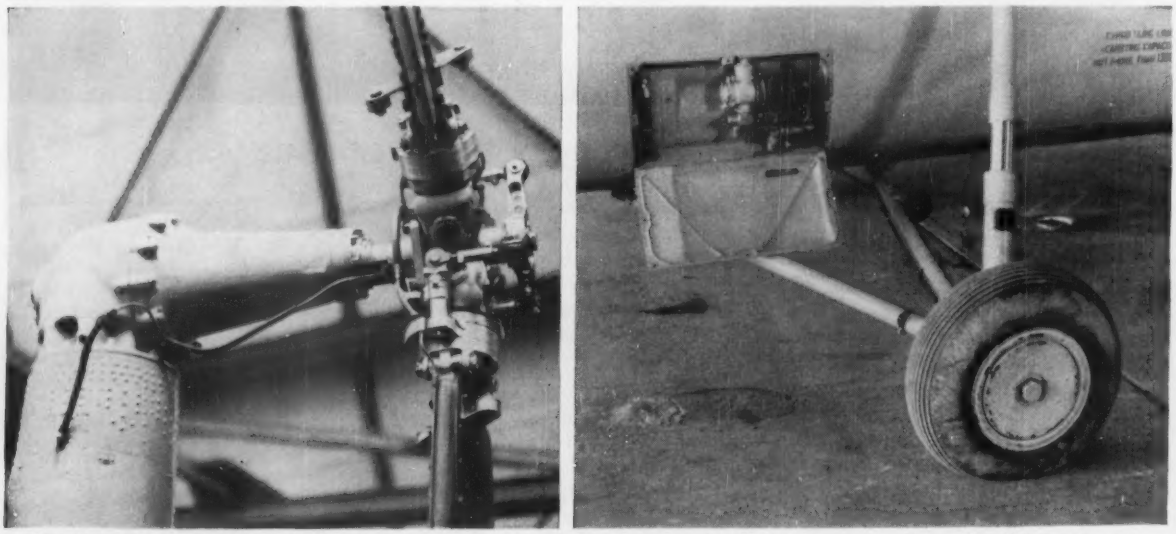
Klagenfurt, Austria – Russian-built Mi-4S helicopter, first to be purchased by any Western country, is being flight-checked here before entering service in resort areas this winter.

The helicopter was bought for a syndicate of Austrian and Swiss hotel operators to carry passengers from municipal airports in the two countries up to tiny clearings in the mountains. In off-season-months the operators expect to use it for freight work as well as passenger flights.

The Russian rotorcraft is the latest modified version of the Mi-4 series and is capable of carrying up to 16 passengers or an externally slung load of 2,860 lb. Purchase price is $200,000, including two sets of spare parts and technical assistance.

Operators are interested in the purchase of a second Mi-4S if operational data from the first one is favorable. They are also thinking seriously of buying the much-larger twin-turbine Mi-6, and exploratory negotiations are scheduled to start soon between their representatives and the Russians.

The Soviet craft is being flown under a temporary 20-hr. permit granted by Austrian civil air authorities while they complete their study of documentation furnished with the Mi-4S. Payload-strength characteristics are currently lacking, says an Air Ministry spokesman, but the Russians have promised to send them as soon as possible. Certification



TAIL ROTOR of Mi-4S is three-bladed (left). Main landing gear (right) is structurally simple. It consists of two drag links and one compression member with hydraulic shock strut. Tire pressure on all four wheels is approximately 60 psi.

ENGINE of Mi-4S is run up on taxiway at Klagenfurt, Austria, airport. Pilot and copilot have good forward visibility. Riveting is clean, straight and with no visible strikeovers. Rotor system and 14-cylinder ASh-82V powerplant are guaranteed for 600 hr. between overhauls.

Mi-4S Sale

is expected to follow as a matter of routine.

Current flying is under the direction of Rafail Kaprelian, chief factory test pilot for the construction group headed by Mikhail Mil, designer of the Mi-1, Mi-4 and Mi-6 series of helicopters. Kaprelian currently holds three world records, two with the Mi-6 and one with the Mi-4 (4,410 lb. payload carried to 19,720 ft.). Ground operations are under the guidance of two Russian technicians, one an avionics specialist, the other an airframe and powerplant mechanic.

Major part of the Russians' duties is instruction of Austrian pilots Biedermann and Feuz, and to check out the ground crew that will take over maintenance and overhaul of the Mi-4S.

In cost, characteristics and performance, the Mi-4 has no direct counterpart in the West. Although it started life in one version as an 11-seat transport comparable in capacity with the Sikorsky S-55, it has almost three times the power and weighs a little more than twice as much. But the Russian practice of starting conservatively has been applied to the Mil design also, and it now carries officially a 3,310-lb. payload, although the world record shows that its capabilities exceed that load limit.

In its present status the Mi-4 is heavier than either the Sikorsky S-58 or the Westland Wessex, has about 200 more installed horsepower, a much larger rotor diameter, and a payload officially placarded at about two-thirds that of

ROTOR BLADES of the Mi-4S are fabric-covered and have rubber fillets on the trailing edges to relieve strain on the blade covering during rotation. Rotor diameter is approximately 69 ft. Blades have built-in alcohol de-icing system; ice-warning indicator is in cockpit.

The U.S. Navy POLARIS, developed by Lockheed:

From ocean depths to any target

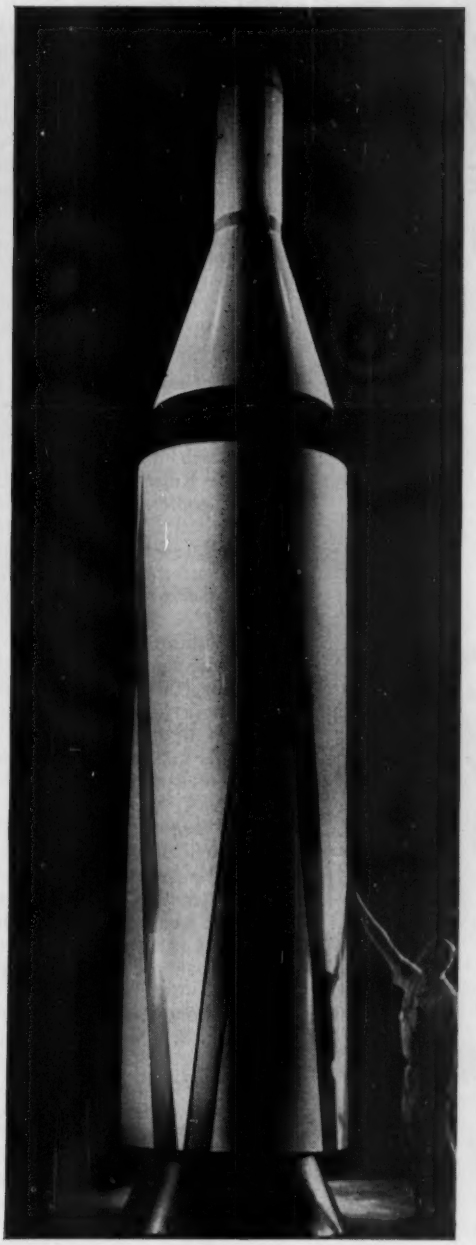
Navy's hidden nuclear submarine (1) launches a solid-propellant POLARIS missile, which erupts from the depths (2), rockets its way into space (3). Plunging earthward minutes later, the warhead of the POLARIS re-enters earth's atmosphere (4) and destroys its target (5).

America can breathe easier next year when the Lockheed-developed POLARIS missile goes to sea aboard the Navy's nuclear-powered submarines—far ahead of original schedule. For every significant military target will be within its ultimate range of 1500 nautical miles.

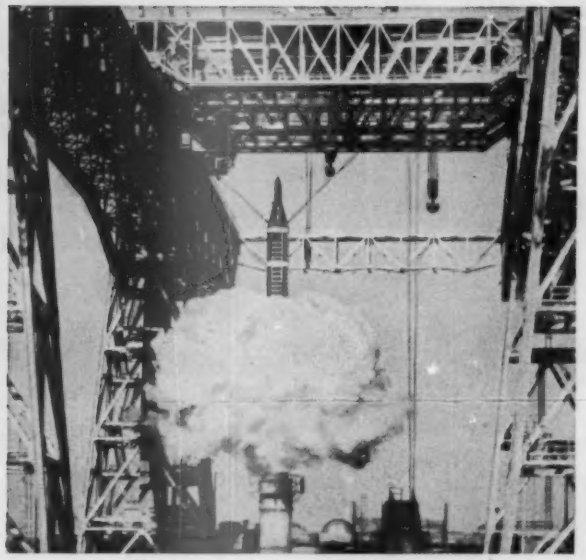
To be an effective deterrent to aggression, a weapon system must be safe from surprise, ready to strike back after any attack. The Navy's POLARIS submarines will be immune to detection as they prowl submerged for weeks at a time. And they'll move the bulls-eye of enemy attack from our soil to the trackless depths of the sea.

Lockheed's Missiles and Space Division is POLARIS Missile System manager and prime contractor – leader of an industrial team that includes Aerojet-General, General Electric, Westinghouse, and hundreds of other contractors and suppliers, large and small. Close cooperation has brought the POLARIS from blueprint to hardware in record time.

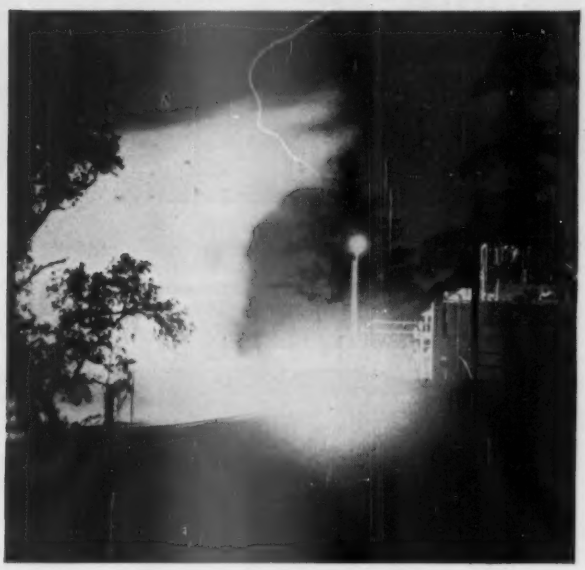
This new combination of nuclear submarine and POLARIS missile will round out the nation's arsenal and give us the flexibility we need for adequate defense.



POLARIS is much smaller than other U.S. ballistic missiles of the same range, thanks to new miniaturization techniques developed by Lockheed scientists. This permits each nuclear submarine to carry 16 missiles.



"Operation Sky-Catch" is apt name for this huge overhead assembly. It catches POLARIS test vehicles in mid-air after test launchings. This prevents damage to components and gives more accurate instrument readings, thus saving time and speeding development. Tests are conducted jointly by U. S. Navy, Westinghouse, and Lockheed.



4,000-acre test base in the Santa Cruz Mountains of California is where Lockheed's Missiles and Space Division puts completed POLARIS missiles through simulated flights that prove the propulsion and guidance systems before actual flights of development missiles.

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either the American or British design.

In cost, there is a substantial difference. The price paid for the Mi-4—regardless of whether or not it represented the actual commercial value of the helicopter—was comparable to the price of a Westland Whirlwind, the British equivalent of the Sikorsky S-55. But for the same amount of money the operators believe they got 50% more passenger capacity and perhaps a less sophisticated airframe to handle better the kind of knocking around they anticipate when the Mi-4 starts lifting timbers out of the high woodlots down to the railroad yards.

Contracting Details

Purchase of the Mi-4 was made by a Vienna import-export house, Schifter & Co., which has been doing business with the Russians in several lines, but not helicopters, for about five years. Ing. Herbert Schifter's experience in negotiating with the Russians tabbed him as a natural for the job, which was the result of a casual conversation he had with one of the representatives of the hotel syndicate.

Contracts negotiated earlier by Schifter for machine tools and other equipment were met to the letter by the Russians, he told AVIATION WEEK. "If you have something specific in a contract, the Russians honor it," Schifter said.

Final negotiations in Moscow were made by Schifter and his lawyer on one side and a handful of Russians on the other, including three top technicians from the Mil group, an Aeroflot executive and a technical representative from the Russian ministry in charge of exports.

Russians guaranteed delivery within four and one-half months of placing the order. In fact, it was delivered within three. Included in the purchase price were two sets of spare parts, "enough to maintain a fleet of 10 helicopters," the necessary special tools, technical assistance and instruction.

The Russians also guaranteed 24-hr. service on parts or components via Aeroflot, and said they would send factory technicians to solve special problems.

The rotor system and the 14-cylinder ASh-82V powerplant carry guaranteed lives of 600 hr. between overhauls. Cost data for the helicopter was not furnished, presumably because—if they exist—they apply too specifically to the Aeroflot operation and would not be applicable to an independent foreign operator.

One figure supplied was the cruise consumption of the engine, given as about 53 gph. This value seems abnormally low for an engine with a cruise horsepower of 1,070; a more normal figure is about twice that.

This specific model of the Mil design

is basically a general-purpose version based on the agricultural model, rather than the transport Mi-4P now in use on Aeroflot shuttle routes. Major reason behind the purchase of the Mi-4S was that the operators wanted a helicopter versatile enough to handle passengers in the cabin or slung loads carried externally. They wanted to be able to keep the utilization high during off-season months by lifting supplies up to lumber camps and cut timber down from the hills.

There are only minor differences in layout between this version and the standard transport. The Mi-4S has three round windows per side instead of the rectangular glazing of the transport. This machine also has both rear-loading clamshell doors with ramp, and a conventional side-fuselage passenger door. The Mi-4P has only the side door. A cargo hook is a basic structural part of the Mi-4P.

This helicopter differs also from several models of the Mil rotorcraft which have a navigator's compartment slung below the main floor in a deep belly blister. Lack of this feature gives the Mi-4S a spindly-legged look.

The size of the Mi-4S seems to be accentuated by the two-tone color scheme used—a dark gray body, with a light cream-colored top. Red and blue "lightning" accent had been painted on by hand between guide lines drawn on the fuselage in pencil. Registration is carried on the upper fuselage, instead of on the tail boom as is practice in Russia.

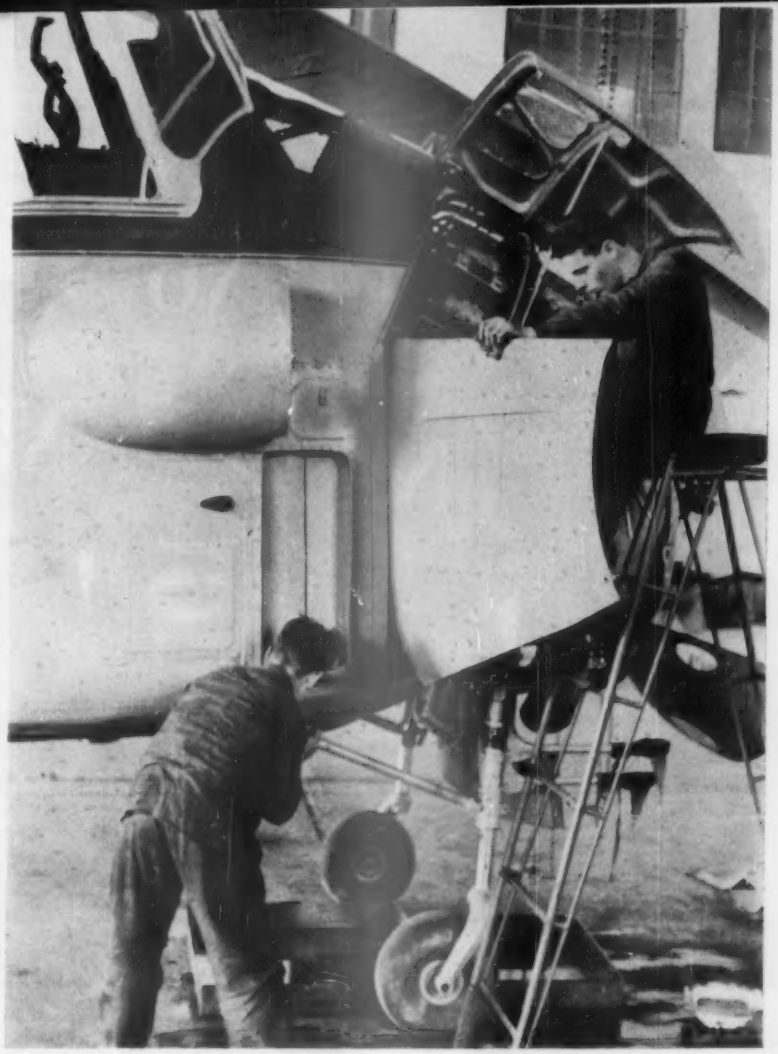
First Walkaround

A first walk-around shows that the Russians have adopted English as the language for all stenciled instructions. In most cases the English is perfect, but a certain unfamiliarity with the idiom has led to a few unintentionally humorous translations from the Russians. For example, the oil cooler filler neck is labeled "Oil pouring out of the oil radiator reducter."

Only visible Russian lettering on the helicopter besides the registration—CCCP 31540—is on the blades, which carry set number and shipping number with Russian letters as a prefix. Data stamp on the blades shows they were manufactured July 16, this year. What is probably the factory serial number—0883—is stenciled at the joint between boom and fuselage.

Austrian engineers and ground technicians are impressed with the over-all mechanical design of the Mil helicopter, and say that it is "idiotensicher," which translates freely as "idiotproof."

The over-all impression is one of excellent workmanship on rotor hubs, powerplants, basic structure and other vital areas. The structure itself is obviously robust. Manufacturing techniques



POWERPLANT SECTION is highly accessible and has many hinged or removable access panels. Color coding in the powerplant bay is done with paint, and entire lines are colored. Engine exhaust system is coated with a ceramic material. Tools are coded with numbers.

MI-4S has rear clamshell doors with ramp and a conventional side-fuselage passenger door. There is a minimum of "no-step" areas on the helicopter. Body is dark gray; top is cream.

Pedigree of a Hound Dog

The guidance and control system of America's HOUND DOG missiles—best of breed—has a pedigree 13 years long. Created by Autonetics, the HOUND DOG's inertial autonavigation system sends this supersonic air-to-surface missile from mother-ship to target anywhere in the world, in any weather. Equipped with an invulnerable sense, HOUND DOG extends the retaliatory effectiveness of SAC's B-52G bombers by hundreds of miles.

Against a 13-year background of blue-ribbon winners, Autonetics is now producing in quantity and at low cost the N5G autonavigator. This is the pedigree that makes the GAM-77 HOUND DOG missile performance "best in show."

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At Autonetics, navigation gyros are made so precisely that it would take over 40 years for one to precess one complete revolution.

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are conventional. Riveting is clean, straight and with no visible strikeovers. Only in some areas is there evidence of sloppy workmanship and these are not in primary structure. Two examples which stand out are the lip around the forward fuselage cooling shutters and a small air exit grill underneath the tail rotor boom.

Powerplant for the Mi-4S is a twin-row, 14-cylinder ASh-82V piston engine with two-stage supercharger, mounted in the nose so that its crankshaft is on a slant upward and toward the rotor mast. This is conventional layout used in the U. S. and England for this type of helicopter.

Continuous cruise power of the engine is 1,070 bhp. at 2,200 rpm. For takeoff and other maximum performance, the five-minute rating is 1,700 bhp. at 2,600 rpm. Emergency rating is a full 2,000 bhp. at 3,000 rpm.

Normal tankage of the Mi-4 series has 264-gal. capacity, but this model has an additional 132-gal. capacity in an auxiliary tank, for a maximum fuel load of 396 gal.

Rotor diameter of the Mi-4S is approximately 69 ft. The four blades are entirely fabric covered, with the exception of a couple of inches at the leading edge which is metal. The blades have a built-in alcohol de-icing system with an icing warning indicator tied to temperature and humidity registering in the cockpit.

Each blade has a fixed trim tab at about two-thirds the diameter. Rubber fillets are let into the fabric covering along the trailing edge at several points, presumably to take the strain on the fabric covering and keep it from ripping. One of the mechanics spent a precarious half-hour before the flight standing on a rickety work platform and an old chair to lubricate these fillets.

Maintenance Design

The Mi-4S shows many signs of design for easy maintenance. There are large numbers of removable access panels in the usual places, and an absolute minimum of no-step areas. In fact, there was not a single stencil saying "No Step" on the entire aircraft. Two mechanics working on the rotor hub walked anywhere on the upper decked structure around the mast. Two footholds, shaped like towel racks, are on each fuselage side, but the window rails and the top of the lateral air scoops were also used by the mechanics as steps without any ill effects showing.

Color coding in the powerplant bay is done with a lavish amount of paint, with entire lines colored instead of simply marked with tape as is the practice in the West. Engine exhaust system is coated with a ceramic material colored dark green, similar to standard coatings used in the U. S.

Two large canvas carriers containing all the special tools for maintenance or overhaul were spread out on the work tables. There were an estimated 80-100 tools, all of good quality and all properly coded with legible numbers.

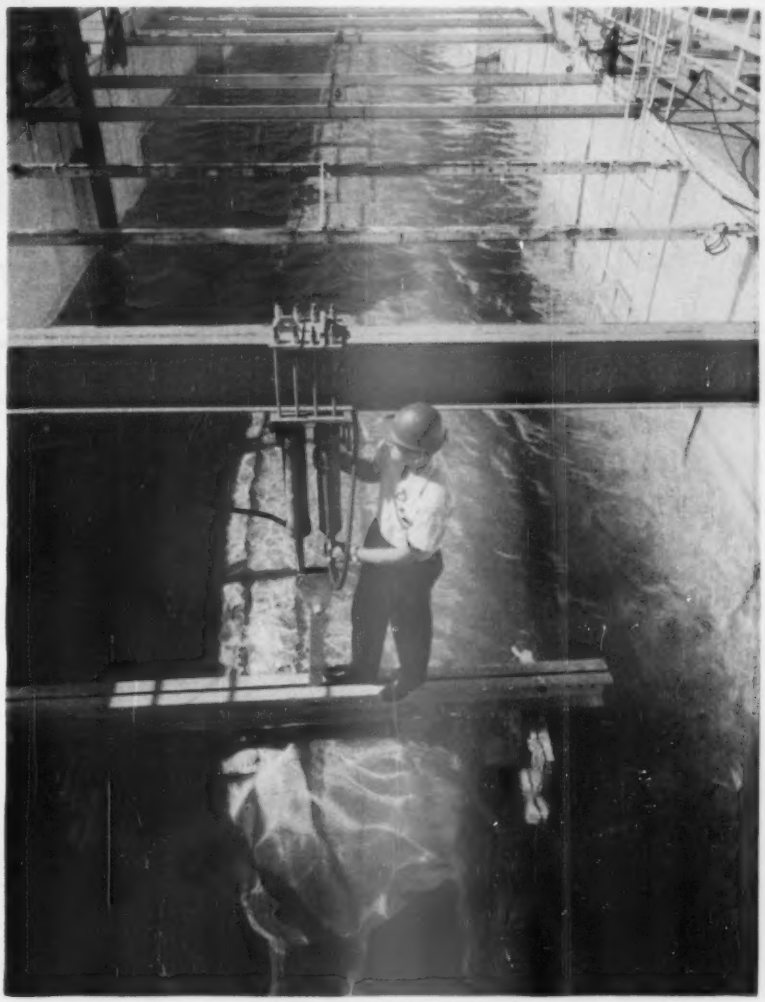
The Mi-4S was delivered from Russia and shipped up the Danube river. It had been packed for shipping with extreme care, say the Austrians, with every part protected individually against exposure. The rotor blades were taken off but otherwise the helicopter was completely assembled. Shipping crate was properly weatherproofed with desiccating agents inside for further protection of parts.

Attachment of rotor blades to the hub was easily done after the big helicopter arrived here, and the engine and rotor system were run on the ground for the usual checkout. At the time of AVIATION WEEK's visit, the helicopter had about seven hours' total time on the rotor system.

At 10 o'clock that morning, the helicopter looked as if it wouldn't fly for a week. But by 11 a. m., when Kaprelian and the two Austrian pilots arrived, the craft was being buttoned up and wiped down. One interesting sidelight: the Russian mechanics were very painstaking in their work and wanted the finished helicopter to look good. One of them kept pointing out smears of oil or smudges of dirt on the fuselage that were to be wiped off by the young apprentice Austrian mechanics working alongside the Russians.

The helicopter was cleared for flight about noontime, and by then the field had closed in to about one kilometer visibility and perhaps a 500-ft. ceiling.

Kaprelian and a Russian mechanic



Convair 880 Fuselage Undergoes Tank Tests

Convair 880 turbojet transport fuselage is suspended by stub wings in water tank at Convair Division of General Dynamics Corp. at San Diego, Calif. Fuselage has been subjected to 56,000 pressurization cycles in five months. Test engineer is adjusting one of the rams that pull upward and downward on submerged fuselage to simulate operational stresses.

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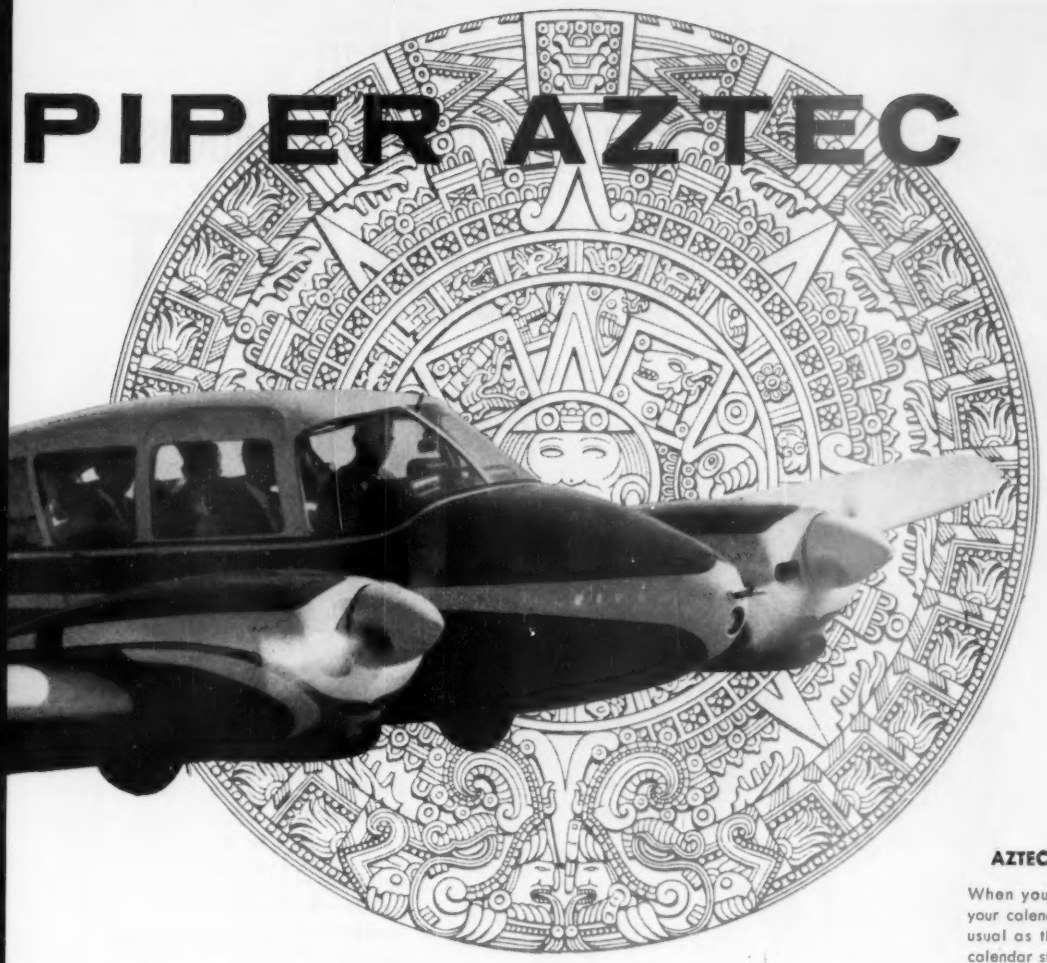

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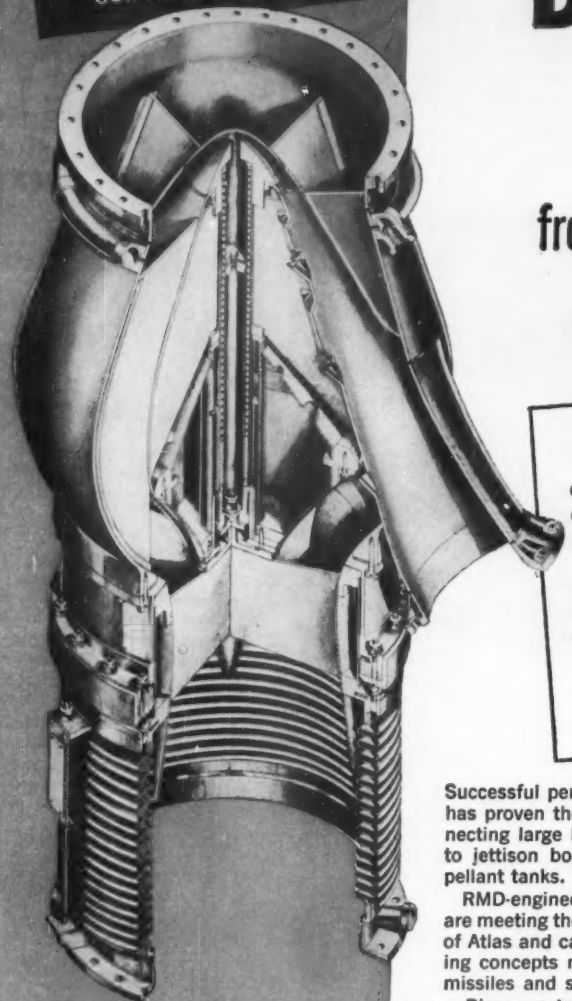

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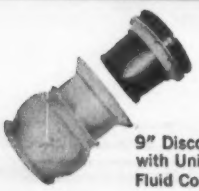


9" Disconnect with Universal Fluid Coupling

8" Disconnect Valve

5" Disconnect (tank mounted)

4" Disconnect Valve

grabbed the tail bumper, the rest of the ground crew pushed wherever there was a handhold, and together they manhandled the Mi-4S out of the hangar, across the apron and up a slight incline to a cleared area.

The mechanic climbed aboard and went through a quick check of controls, cycling the blades through their full angular deflection range with the collective pitch control. Then Kaprelian and Biedermann took over as pilot and copilot.

The ASh-82V engine fired, belching gray clouds of rich exhaust fumes over the apron. A mechanic used a long pole with a heavy canvas loop on one end to engage each rotor blade individually and pull it forward against what was obviously a stop in the rotor hub system somewhere. When he completed this for the fourth blade, the rotor started to rotate very slowly and continued this rotation during engine warm-up.

With engine revved up to full power, Kaprelian engaged the rotor system and the drooping blades began to whirl, accelerating rather more rapidly than other types familiar to this observer. A short run with rotor at zero lift was followed by disengagement of the rotor, which slowed and then continued to drift while the engine was idling. Mechanics climbed into and out of the helicopter and then, with most of the ground crew back on the ground, Kaprelian again revved up the engine, engaged the rotor, held it at lifting rpm. for a few seconds, and increased the collective pitch for the takeoff.

The Mi-4S lifted off nose-high and a little awkwardly, backed up a few feet and then held at about 10 ft. off the ground for a few minutes of hovering. Wind was about 15 mph., driving a light rain before it; it was not gusty, but the Mi-4S seemed to be hovering unsteadily as if there were sharp gusts.

From this low altitude the helicopter rose to about 50 ft. and held there for several minutes, hovering and backing, once or twice rotating about its vertical axis at a low rate. Then Kaprelian flew from over the apron to a point near the control tower about a quarter-mile away and proceeded to do a series of vertical landings and takeoffs out of hovering at less than 100 ft.

This was followed by a landing on the main runway, and long minutes spent taxiing up and down the length of the field. At one point the helicopter was stopped about in the middle of the runway and everybody got out, huddled under the tail boom for a while and then got back in to repeat the lengthy taxiing routine again.

During all the takeoffs, the lift-off was clumsy and nose-high. It was not possible to observe which pilot was handling the airplane, although Kaprelian had definitely made the first takeoff.

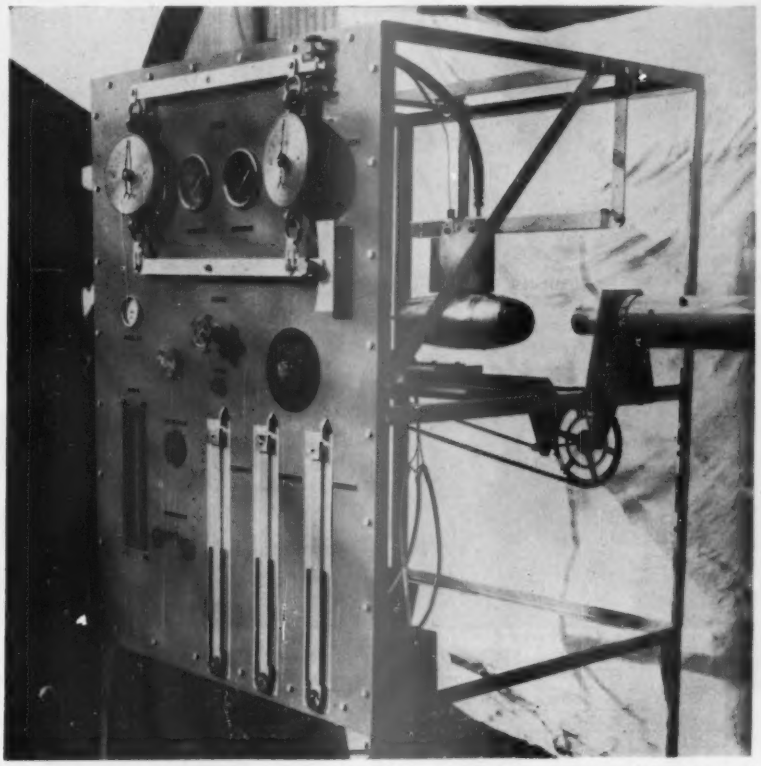
Total rotor time during this observed test was about two hours, bringing the time of the machine up to about 10 hr.

The real performance of the Mi-4S will not be known until the cost operational figures are in, and the Austrians have bought another for comparison, and maybe have traded figures with the Austrian Air Force now operating a fleet of Westland Whirlwinds. Thus any analysis of the true cost of the Mi-4S is some time off in the future.

But the real significance of the Austrian purchase is that it marks the entrance of the Russians into the commercial aircraft market in a serious way. The contract, the preparation of the helicopter for shipping, the complete documentation furnished with the craft, the conditions of technical support and training, the presence of the top helicopter pilot in the USSR, all point to a studied effort on the part of the Russians to meet and beat Western offers.

Commercially this single sale of a helicopter to a small operator has great importance. Nobody believes this is a one-time affair to gain prestige or to try out the experiment of selling to the West. Most European observers who know about this purchase are inclined to agree that it is a serious start by the Russians in a field they have neglected up to now.

And knowing the past performance of the Russians in other commercial deals, they agree that the future will bring more and more of such trading, and place the Russian aircraft industry in a strong competitive position with respect to its European and American counterparts.



RAMJET test stand shows thrust measuring linkage, chain-driven, water-cooled probe position indicator and manometers.

Ramjet Designed as Teaching Aid

London—Subsonic ramjet engine has been developed by P. A. Hilton & Co. for use by British colleges and universities in demonstrations of basic thermodynamic processes common to all heat engines.

The unit burns propane gas, is supplied with air up to 300 fpm. from an 8 hp. compressor, and develops a maximum 3 lb. thrust. Unhampered by a rotor system, the ramjet has advantages in the instructional field as it enables the measuring probe to traverse along the whole length of the engine without obstruction, and provides a complete picture of the thermodynamic cycle.

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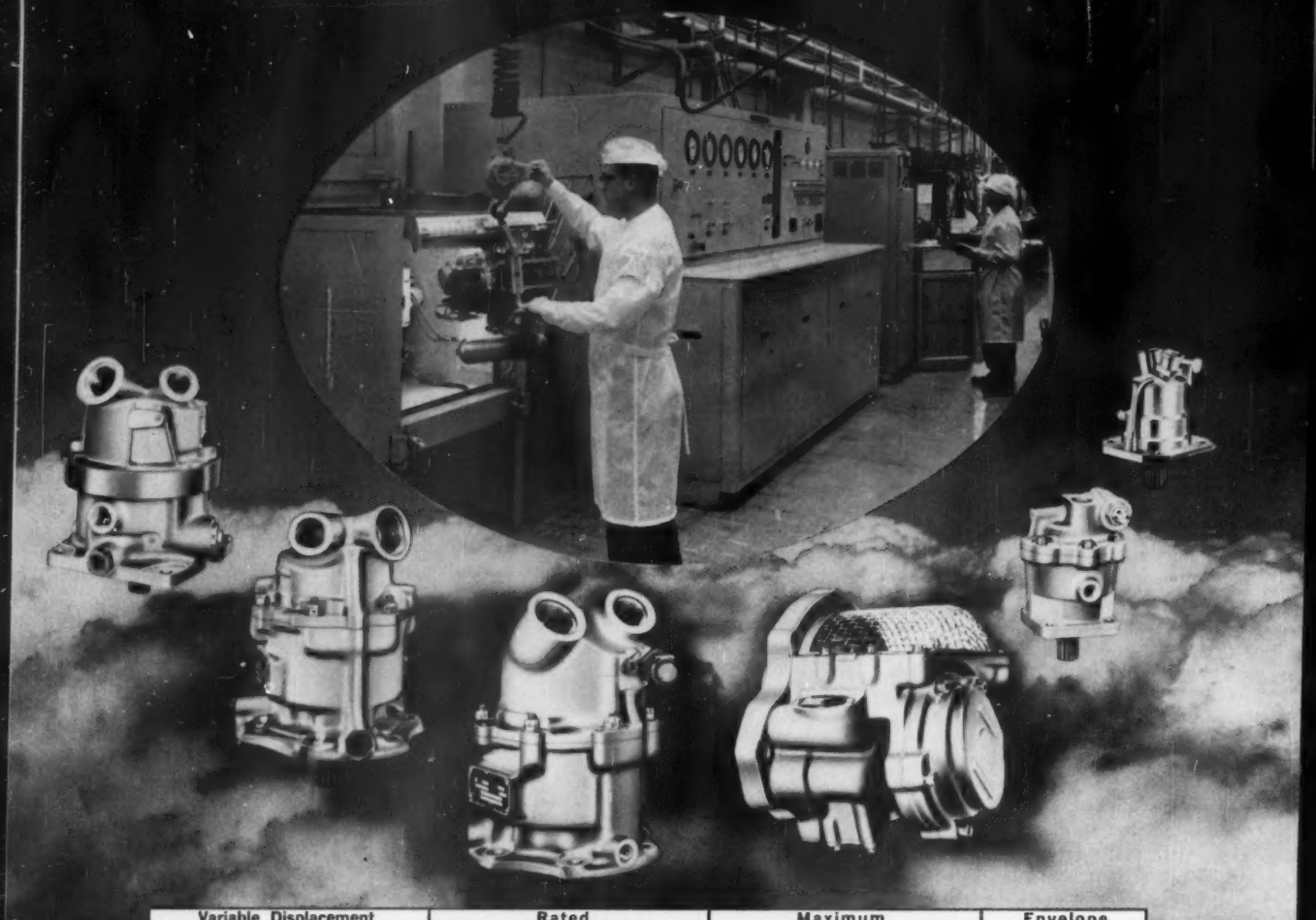

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P65	.65	8.1	6000	16.2	.286	9000	24.6	.188	4.66	6.00
P56	.568	8.1	7000	16.5	.281	10000	23.9	.194	4.66	6.00
P16	.163	3.5	12000	8.0	.250	16000	10.8	.185	3.50	4.75
P11	.115	2.6	12000	5.7	.261	16000	7.7	.193	3.25	4.47
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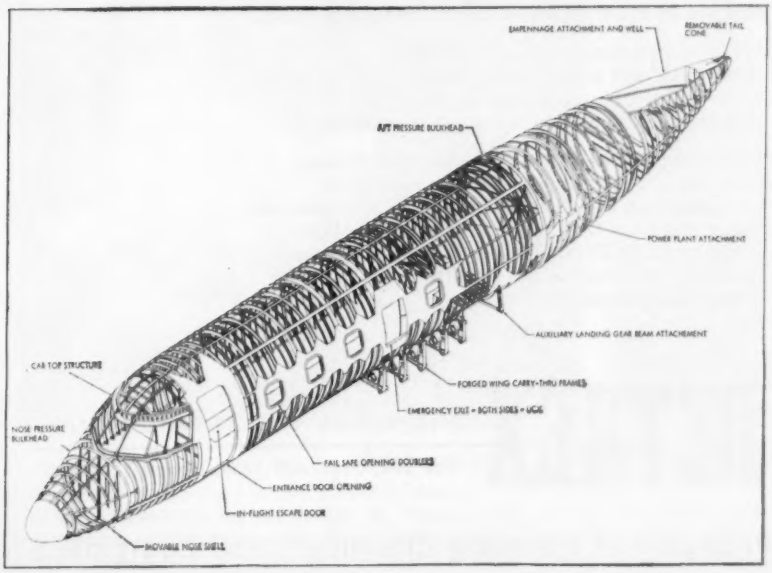
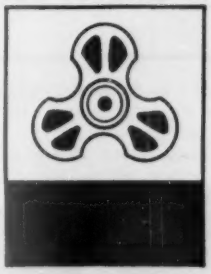
m. long and is mounted on a hydraulically damped thrust measurement linkage in the test stand. The stand is fully instrumented and contains all controls needed to measure intake efficiencies, compression processes, addition of heat through combustion, and work done in the expansion process. It is ignited by a spark plug and trembler coil with power supplied by a small dry battery.

The complete installation has been specially developed for instructional purposes from a rig used for a helicopter rotor tip propulsion experimental program. Cost of the unit in Britain is $2,000 and the first equipment has been installed in London's Imperial College.

Lockheed JetStar Headed for Stress Tests

First production fuselage of Lockheed JetStar turbojet transport is lifted from its main assembly jig for transfer to static testing facility at Marietta, Ga. Plane is assembled in a single 52-ft. long jig (over-all plane length is 60-ft. 4½ in.). Engineering innovations include use of circumferential forged rings to support carry-through frames in place of box beams (see below). Basic shell structure of center fuselage is composed of 11 longerons supported by formed metal channel section rings. Hoop tension stresses are limited to 12,000 psi. due to maximum operating cabin pressure. Stress tests include subjecting fuselage to pressurization of 12.7 psi. and simulated 3-5 in. per hour rainstorm.





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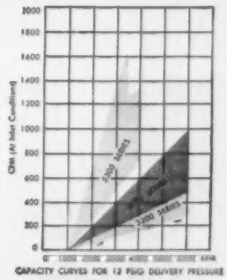

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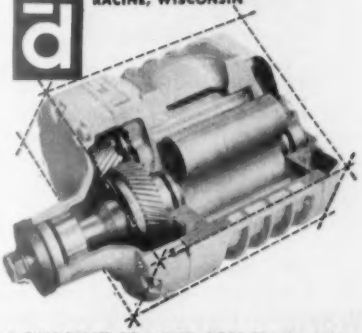

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British Accident Investigation Report:

Debris Jams Elevator Control, Leading to Crash of Transport

(Following is a report to the British Minister of Transport and Civil Aviation by J. W. Duggan, deputy chief inspector of accidents, into the circumstances of the accident involving a Handley Page Hermes 4 G-ALDV which occurred Apr. 1, 1958, at Manor Farm, Meesden Green, England. All three crew members were killed; the aircraft carried no passengers.)

The aircraft was on a routine test flight. Fourteen minutes after takeoff the Air Traffic Control officer at Stansted heard a radio transmission from the aircraft in which the second pilot said that the controls were "jammed." Witnesses observed the aircraft descending in a series of dives and climbs until it crashed and caught fire.

THE AIRCRAFT

The aircraft was constructed in 1950 and first registered in the name of British Overseas Airways Corp. It was registered in the name of Skyways, Ltd., in February, 1955. A Certificate of Airworthiness was issued in September, 1950, and was valid at the time of the accident. The aircraft had been maintained in accordance with an approved maintenance schedule. Since the last check 4 inspection in February, 1957, the aircraft had flown 2,526 hr. and 299 hr. since the last check 3 inspection in February, 1958.

A check 1 inspection was completed on Mar. 31, 1958, and during this inspection No. 2 and 4 engines were changed. Because of the change of engines an air test was then required in accordance with company practice. The aircraft was certified as fit for flight at 1,000 hr. on the day of the accident.

The aircraft had flown a total of 12,697 hr. of which 5,984 were flown by Skyways, Ltd. The calculated weight at takeoff was 63,621 lb. and the center of gravity was within the prescribed limits. The maximum authorized weight of the aircraft was 86,000 lb.

THE CREW

Capt. G. D. Rayment was in command and was acting as pilot-in-charge when the aircraft took off. He was 38 years of age and held a valid Airline Transport Pilot's license endorsed in Group I for Hermes aircraft. His flying time amounted to 10,521 hr. of which 2,802 were in Hermes aircraft. He had been employed by Skyways, Ltd., since April, 1949, and at the time of the accident was the company's chief test pilot and senior check pilot.

Capt. J. A. West was 38, and held a valid Airline Transport Pilot's license with an endorsement in Group I for Hermes aircraft. His flying time amounted to 7,497 hr. which included 744 in Hermes aircraft. He had been employed by Skyways, Ltd., since April, 1953, and was promoted to captain in August the same year. When the aircraft took off Capt. West was acting as second pilot.

Engineer Officer N. Bradley was 35 and held a valid flight engineer's license endorsed for Hermes aircraft.

The weather was fine and had no bearing on the cause of the accident.

The aircraft took off on a test flight from Stransted Airport at 1059 and climbed steeply toward the northwest. A few minutes later it was observed approaching the airport from the west at a height of approximately 1,500 ft.

At 1113 the Air Traffic Control Tower received a radio call in which Capt. West declared an emergency and said that the controls were jammed. Half a minute later he said that the controls were completely jammed and that the aircraft was about to hit the ground.

About the same time the aircraft was seen some six miles northeast of the airfield descending in a series of dives and climbs. It crashed in a field and the crew was killed.

The greater part of the wreckage was destroyed by fire.

Inspection at the scene of the accident showed that the aircraft had struck the ground on a heading of 040 deg. magnetic while descending at an angle of approximately 14 deg.

The wreckage trail extended over a distance of approximately 200 yd. The fuselage had broken at the center section and that part containing the flight deck had turned through nearly 180 deg. The port wing had been torn off, all four engines had broken away and apart from the empennage the wreckage had been severely burnt. An examination of the control runs in the fuselage and on the flight deck for signs of jamming was without result.

OBSERVATIONS

A force of between 110 and 115 lb. at the control linkage attachment point is equivalent to a force of 55 to 60 lb. at the spectacle of the pilot's control column. As the marks found on the datum lever after the accident are deeper and more extensive it must be supposed that they were formed by the application of a greater force than

Scavengers Strip Downed DC-3

Thorough job of stripping a stricken aircraft by souvenir hunters is shown in these two pictures of a Piedmont Airlines Douglas DC-3 that crashed near Charlottesville, Va., on Oct. 30. Picture at left, showing tail assembly and aft section of the fuselage, was taken Nov. 9. All that remained of this section of the aircraft after scavengers had worked on it is shown in the second picture taken from approximately the same location on Dec. 2. Site of the accident is in thickly-wooded mountainous area accessible only after a 1½ hr. uphill hike.

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that produced in the laboratory. It is reasonable to suppose that it was within the capabilities of the polits to apply enough effort to force the object which caused the score marks on the datum lever between the relevant components and to move the controls to some extent. The resistance of the jammed components to movement would cease suddenly when the controls approached the neutral position and the locking slots in the datum lever and the locking latch housing came into alignment. It is unlikely that the pilots would be able to anticipate this and avoid overmovement and jamming on the other side of the slots.

It is evident from the appearance of the score marks that several such movements did take place. The heaviest scoring undoubtedly resulted from the progressive distortion of the object causing the jamming and it is reasonable to deduce that the force required to move the jammed controls became more than the pilots could exert.

The difficulty of keeping the aircraft free from extraneous objects is something that constructors and operators have always been aware of as the structure of aircraft is such that small objects can find their way into crevices and inaccessible places. The importance of guarding against this happening and the necessity for absolute cleanliness cannot be emphasized too strongly.

CONCLUSIONS

1. The documentation of the aircraft was in order.

2. The gross weight was below the authorized maximum and the trim was within the prescribed limits.

3. The crew was competent and properly licensed.

4. The elevator controls of the aircraft became jammed as the result of fouling of the elevator mechanism by a small extraneous object which was not found.

5. It was not possible to identify the object or to say how it entered the aircraft.

The wreckage was removed to a site with workshop facilities where the control mechanism in the stern frame bay was dismantled. Deep bright score marks were found on the face of the port side elevator datum lever adjacent to the locking latch housing which are movable and fixed parts of the elevator control system. The appearance of these marks under microscopic examination indicated that a hard object such as a small split pin had fouled and jammed the mechanism. Judging by the depth and width of the score marks it was clear that considerable force had been applied to operate the elevator controls. The object referred to above, in spite of an exhaustive search, was not found and it is presumed that it was displaced when the aircraft struck the ground.

Several small extraneous objects were, however, recovered from the stern frame bay. Thereupon an inspection of the stern frame bay of another Skyways Hermes aircraft was carried out and a similar assortment of extraneous objects was found. The attention of the Skyways' inspection department and the Air Registration Board resident surveyor was drawn to the matter at once. Experiments were carried out on a Hermes aircraft in which a piece of 14 swg. brass wire was introduced into the appropriate part of the control mechanism and an attempt was made to operate the elevator controls from the cockpit. It was found that they could be moved only with the greatest difficulty. Laboratory examination of elevator datum lever taken from the crashed aircraft showed differences in the color of the oxide film among the score marks on one side of the locking slot indicating that some of these marks were of a greater age. The marks of more recent origin were superimposed on the others. The appearance of the superimposed score marks indicated that they were made on the same occasion as those on the other side of the locking slot where there is no evidence of previous scoring. There is, however, no record of any previous stiffness or jamming of controls.

Similar but shallower and less extensive marks were reproduced on the starboard side elevator datum lever of the same elevator control unit in a laboratory experiment.

A test rig was constructed so that the unit was rigidly supported and the datum lever operated by a tensile load applied to the control linkage attachment point. This load could be measured against a scale. A new $\frac{3}{32}$ in. split pin was introduced between the datum level and the latch housing. It was found that the split pin could be forced between the two components by the application of a load of between 110 and 115 lb. and that considerable force was necessary to return the datum lever to its neutral position. This force could not be measured because the testing machine was not reversible but it is considered that it was in the order of, or possibly more than, 110 lb. The reversal of the jamming when the mechanism was forced back could well have distorted the split pin further and progressively increased the force necessary to move the datum lever. The datum lever was removed from the unit and an examination of the scores produced showed them to be shallower but very similar to those on the port side datum lever.

The accident was caused by the elevator mechanism becoming jammed. This deprived the pilots of control of the aircraft. The jamming was due to the presence of a small extraneous object which entered the control mechanism.

J. W. Duggan
Deputy Chief Inspector of Accidents

FAA Plans to Designate Pilot Medical Examiners

Federal Aviation Agency proposes to require applicants for student, private pilot certificates to secure medical examinations from designated examiners.

The FAA will hold an informal public hearing Jan. 14 in Washington, D. C., to give persons an opportunity to express opinions on the proposal.

Any competent, licensed physician can now give a physical examination to student and private pilot applicants—a practice stemming from the shortage of designated medical examiners during World War II. The number of examiners could now be increased in different geographical areas to give the examinations without unnecessary inconvenience to applicants, FAA says.

FINANCIAL

Chance Vought Enters Mobile Homes Field

Dallas, Tex.—Chance Vought Aircraft is contemplating a national distribution-manufacturing setup in pushing its entry into the U. S. trailer homes industry (AW Dec. 14, p. 35). New venture is another indication of the company's diversification program (AW Oct. 26, p. 125).

The company acquired, by stock purchase, two large mobile home firms and signed a purchase agreement with a third. It will operate the three through a wholly owned subsidiary, Vought Industries, Inc. The acquisitions are: General Coach Works, Marlette, Mich., and ABC Coach Co., Clarion, Pa. It also has signed a purchase agreement with Mid-States Corp., Battle Creek.

The three firms, which operate more than a dozen facilities, last year grossed a total of more than $60 million.

Vought Industries, Inc., which will be under the direction of Clifford E. Burt, formerly vice president-finance, Chance Vought, Inc., will have its headquarters in Dallas. Manufacturing of mobile homes will continue at present facilities of the new acquisitions and there are no plans to bring any into the aircraft facility, he said.

Burt indicated that Vought Industries is considering a broad long-range expansion of its new acquisitions.

Among initial steps under consideration, he said, are: establishment of a nationwide system of coordinated manufacturing facilities to counteract the present problem of high transportation costs, a national marketing and distributing system, and scientific planning of product development to provide a widely diversified product line, bracketing all price ranges.

Also foreseen are systematized financing and insurance plans for deeper market penetration, national advertising programs tied to the dealer organization and warranty and service programs.

Two British Groups Study Merger Plan

London—Stock exchange offer made by the Hawker Siddeley Group, Ltd., for the Blackburn Group will be one of the biggest aircraft industry mergers to take place so far, if it succeeds.

Terms of the offer are one Hawker Siddeley ordinary share ($2.08) for each of the 2,750,436 ordinary shares ($1.04) in Blackburn. Additionally, special capital dividend of 14 cents per share will be paid to Blackburn holders out of

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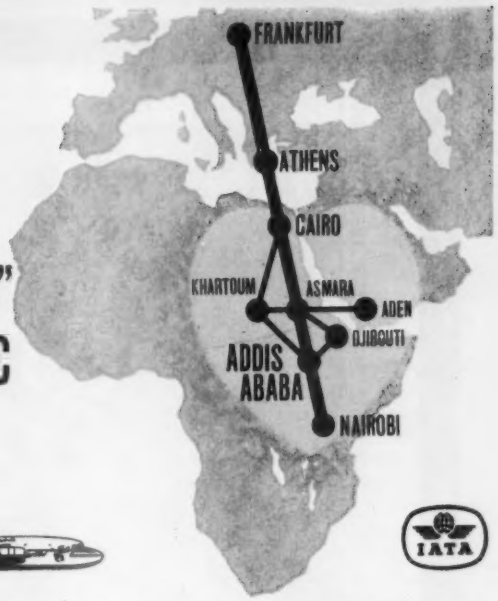

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profits on a recent property sale.

Share exchange basis of the offer puts a value of about $12.3 million on the Blackburn Group.

Blackburn Group currently is manufacturing the NA-39 strike bomber for the Royal Navy at its Blackburn and General Aircraft, Ltd., plant near Hull. Besides Blackburn Aircraft, the Blackburn Group includes Blackburn Engines, Thomas Green and Son, Ltd., London Air Syndicate, Ltd., and Universal Flying Services, Ltd.

Blackburn also is engaged on a range of developments on the engine side of the aircraft industry. It has a large number of orders for the French-designed Palouste gas turbine for starting the engines of naval and Royal Air Force aircraft, and is making the Artouste for use as an auxiliary power plant.

Other Blackburn interests include agricultural equipment and electronics.

Hawker Siddeley ranks as one of Britain's major aircraft groups, taking in Armstrong Siddeley Development Company, Ltd., Hawker Aircraft, Ltd., A. V. Roe, Ltd., and Gloster Aircraft Co., Ltd. Last August, it took over Folland Aircraft, Ltd., at a price of about $2.2 million. It is extensively engaged in the industrial and nuclear fields.

New Offerings

Greer Hydraulics, Inc., Jamaica, N. Y., engaged in the design, development and manufacture of aircraft and missile ground support equipment, etc. Offering is additional shares of common stock, 50 cents par value, to be offered for subscription by the company's common stockholders. Proceeds will be applied first to payment of costs involved in the relocation of the company's operations from New York to Los Angeles (estimated cash expenditure to be not in excess of $300,000); balance will be used to reduce current obligations and for general corporate purposes.

Benson Manufacturing Co., Kansas City, Mo., a precision metal fabricator specializing in aluminum and magnesium, stainless steel, and titanium; the company serves missile, rocket, and aircraft companies through its Missile and Aircraft Division. Offering is $2,000,000 of 6% convertible debentures, due 1971, and 130,000 shares of common stock, $1 par value, to be offered for public sale. Proceeds will be used to purchase additional manufacturing equipment; to purchase buildings now leased; to retire the company's $500,000 outstanding bank loan.

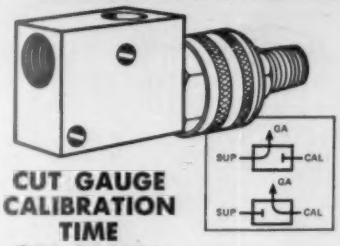
Lake Aircraft Corp., Sanford, Me.; company was incorporated in August, 1959, and proposes to engage in the manufacture, distribution, and sale of aircraft. Offering is 135,000 shares of Class A common stock, 10 cents par value, for public sale at a price of $3.00 per share. The company has purchased Colonial Aircraft Corp.'s assets that were associated with its program for the production of Skimmer amphibians (AW Nov. 2, p. 118); agreed purchase price was $164,350 payable $141,800 in cash and the balance by 8,200 shares of Lake Aircraft's Class A common stock, valued for this purpose at $2.75 per share (since increased to 16,400 shares by stock dividend). Lake Aircraft has paid $100,000 and has issued the stock on account of the purchase price. Of the proceeds from the offering, the first $25,000 will be applied to bank indebtedness, and next in conjunction with cash on hand to the payment of the balance of the purchase price of the Colonial assets, remaining indebtedness, and other expenses. Any balance will be used as working capital and general corporate purposes.

Financial Briefs

Summers Gyroscope Co. preliminary figures indicate that October was the company's first profitable month since January, 1957. Summers reduced its losses from $4.2 million in 1957 to $1.3 million in 1958 with support from Atlas Corp. (AW Aug. 31, p. 39). Billings for September and October were $552,000 and $1,041,000 respectively and nine-month sales totaled $4,200,000. The Atlas Corp. invested almost $3,200,000 in Summers since early 1958, including $300,000 invested by Mercast Corp. Summers' V-loan, which was substantially guaranteed by USAF, had a ceiling last year of $2,500,000, but this has been increased to $3,250,000. Creditors' claims accrued before January, 1958, totaled $1,096,000; these have been exchanged for stock. Stockholders recently voted to increase capital stock from 10 million shares to 15 million shares because an inadequate amount of shares remained uncommitted. Backlog was $10 million on Nov. 1.

Gyrodyne Co. of America, Inc., net sales for the six months ended Oct. 31 were $1,020,048 compared with net sales of $388,672 for the comparable 1958 period, and with $985,388 for the fiscal year ended Apr. 30, 1959. Net income for the half year ended Oct. 31 was $59,305 compared with net income of $19,554 for the six months ended Oct. 31, 1958, and with $53,200 for the year ended Apr. 30, 1959. The company's backlog was $4,200,756 on Oct. 31, compared with $1,008,567 on Oct. 31, 1958.

Hawker Siddeley Group's net profits for the year ended July 31 were up to



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$17.5 million from the previous year's $14.3 million. Of the net, $3.4 million came from the Group's Canadian operations—A. V. Roe (Canada) and Dominion Steel and Coal Corp.—and the remaining $14.1 million from U.K. operations.

Packard Bell Electronics Corp. achieved record sales of $46,608,062 in the fiscal year ended Sept. 30, compared with Fiscal 1958 sales of $37,371,081. Profits also set a record—$1,375,346 for Fiscal 1959, compared with the previous year's $1,002,594. Net income was $1.73 a share on 792,600 shares outstanding for the 1959 Fiscal year; last year it was $1.46 a share on 688,000 shares.

Servomechanisms, Inc., had a net loss of $246,000 for the three quarters ended Sept. 30, and net sales of $10,816,000. During the first nine months of 1958 Servomechanisms made a net profit of $104,000 on net sales of $13,535,000. Net loss was $2,000 for the quarter ended Sept. 30, on net sales of $3,673,000.

Aeroquip Corp. net earnings were a record $2,711,280 for the fiscal year ended Sept. 30 and represented a 20% increase over Fiscal 1958 earnings of $896,458. This year's earnings equaled $2.27 a share on 1,194,135 common shares outstanding; last year's earnings were 75 cents a share on 1,156,944 shares; a 3% stock dividend paid in 1959 is taken into account. Net sales for Fiscal 1959 were $48,232,437, compared with $35,686,930 for the previous fiscal year.

Sales of $6,670,000 of business aircraft in November gave Beech Aircraft Corp. its biggest dollar volume month for executive aircraft in its history, compared with $3,044,000 for the same period last year. For the first two months of its 1960 fiscal year (October-November), Beech sold $9,080,000 worth of business aircraft, compared with $5,408,000 for the same period last year. Volume is based on consumer list prices, including optional equipment.

Contracts totaling $26 million for Bell HU-1A turbine-powered helicopter follow-on production and development of a new HU-1B have been received by the company from Air Force, which administers the program for the U. S. Army. HU-1A production now is extended through 1961. HU-1B is fitted with a Lycoming T53-L-5 turbine and new dynamic components, permitting an increase in shaft horsepower to 1,000 shp., compared with the HU-1A's T53-L-1A, which delivers 770 shp. Later model also has wider chord main rotor blades increasing disk solidity. Transport version of HU-1B carries eight plus pilot and copilot.

Net earnings of Braniff International Airways for first nine months of 1959 were $2,106,271, or 71 cents per share, up 41.2% over the same period last year. Earnings comprised $1,833,036 from operations, compared with $1,206,803 last year, and $273,235 from sale of surplus equipment compared to $285,049 in the first nine months of 1958. System load factor for the nine month period increased from 56.76% to 58.85%. Revenue plane miles declined 3.04% from the 1958 period, but salable seat miles operated increased 1.42%, revenue passenger miles 5.15%, mail ton-miles 12.97%, express ton-miles 21.98% and airfreight ton-miles 23.56%, indicating influence of the new Lockheed Electra turboprop equipment.

Missile Systems Corp., Los Angeles (AW Oct. 26, p. 127), reported consolidated earnings of $114,351 or 36 cents per share on 316,421 shares of common stock outstanding for the six months ended Oct. 31. Consolidated sales for this period were $623,116. Backlog rose from $503,784 on Apr. 30 to $1,885,913 on Oct. 31, a 275% increase.

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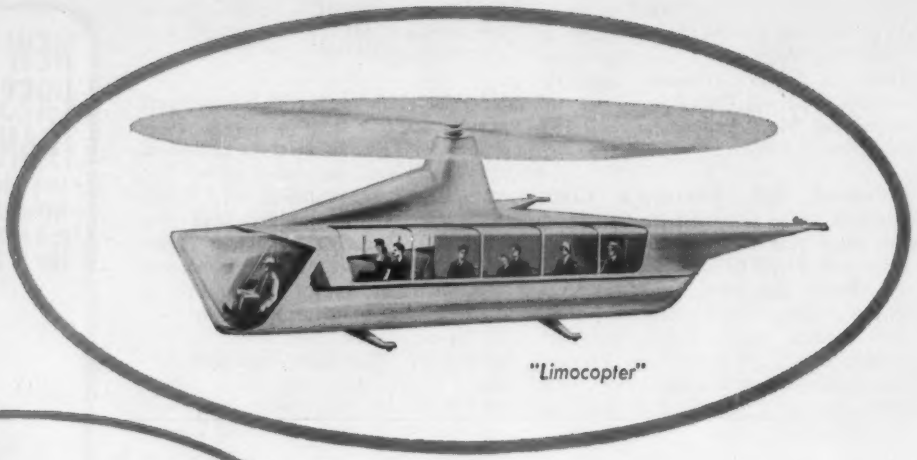
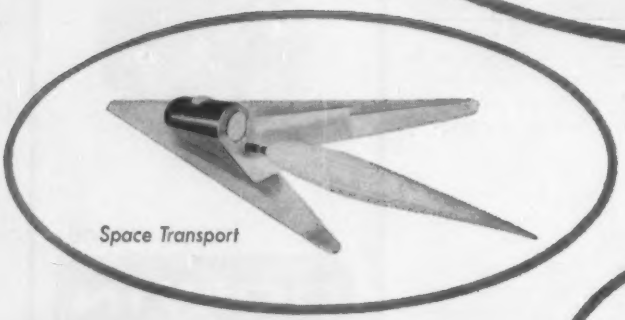


"Limocopter"



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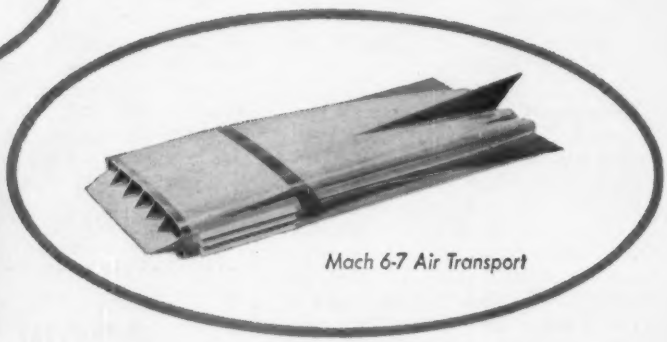

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This markedly expanded program into the total concept of flight creates urgent need for personnel with high-level skills. The concept ranges from subsonic to hypersonic speeds; from atmospheric to outer space vehicles.

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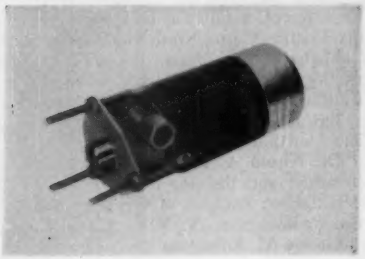
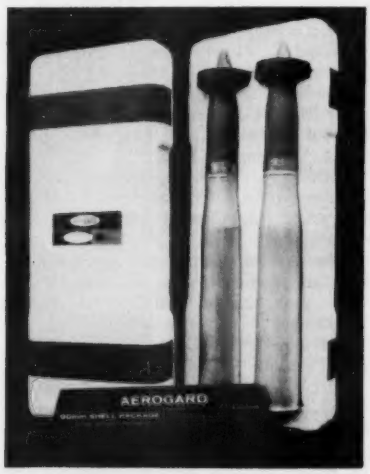


and 1.65 lb. with the thermal protector. Specifications include: 400 cps., 115/200 v., 4 poles, 3 phase, 11,400 rpm. Pump pressure rise is 25 psi. at 5 gpm. The pumps are manufactured with a choice of ¼ in. inlet and ⅛ in. outlet female fittings and ⅜ in. male tube fitting.

Task Corp., 1009 E. Vermont Ave., Anaheim, Calif.

Plastic Foam Container

Aerogard shipping containers are constructed of plastic foam covered with a fabric skin. Containers are shipping items requiring careful handling such as artillery shells (below), avionic components and medical supplies.

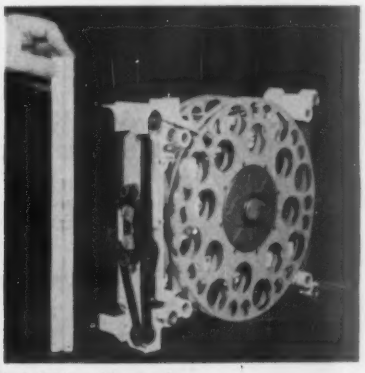


The plastic foam packages are said to be 75% lighter than similar wooden packing cases, and to provide more protection in the event of severe impacts and will float.

Aerojet-General Corp., Structural Plastics Division, Azusa, Calif.

Boeing Develops Starter for Swissair

Pneumatic starter system developed by Boeing Airplane Co.'s Industrial Products Division for Swissair is built around a Boeing gas turbine as the power source; system delivers about 120 lb./min. of air at a pressure of about 40 psi. and temperatures up to about 450F. Unit will be used by the airline for starting turbine-powered aircraft at Zurch-Kloten, Geneva-Cointrin, Basle, Lisbon and New York International airports. The unit shown is the first of seven ordered from Boeing and is mounted in a German Ford Taunus panel truck. Six similar starters have been ordered by Swissair from Auto Diesels, Ltd., of Uxbridge, England, built around that company's system.



Satellite Recorder

Tape recorder to be carried on the Project Mercury man-in-space flights weighs 12 lb. and has 4,800 ft. of magnetic tape.

The recorder will monitor the astronaut's voice commentary, sensitive pick-ups taped to his body and such environmental data as cabin temperature, pressure, acceleration and shock. The unit weighs 9 lb. without tape, measures 11 x 13 x 3⅜ in. and requires less han 8 watts of power.

Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

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WHO'S WHERE

(*Continued from page 23*)

Changes

A. G. Puglisi, chief engineer, Douglas Aircraft Co.'s Tulsa, Okla., Division, and **E. S. Rutowski,** assistant chief engineer.

Samuel Romano, manager of the newly formed Undersea Warfare Group of the Advanced Development Laboratory, Avion Division of ACF Industries, Inc., Paramus.

James G. Weldon, manager, Hydraulic Department, Bendix-Pacific Division of Bendix Aviation Corp., North Hollywood, Calif.

Michael Burlingham, director of engineering, Burton Instruments, a division of Burton Manufacturing Co., Santa Monica.

Ray E. Anderson, chief engineer, Dorne and Margolin, Inc., Westbury, N. Y.

Dr. Nisson A. Finkelstein, assistant vice president and director of research, Stromberg-Carlson Division of General Dynamics Corp., Rochester, N. Y.

George M. Robertson has been appointed assistant for administration on the staff of the vice president of Convair and manager of Convair (Astronautics) Division of General Dynamics Corp., San Diego, Calif.

William C. Ray, responsible for government aviation sales, Transportable Systems Division of Alpha Corp., a subsidiary of Collins Radio Co., Richardson, Tex., and **Victor J. Hancock,** responsible for commercial aviation sales and flight operations.

Herbert I. Chambers, associate director, DataTape Division, Consolidated Electrodynamics Corp., Pasadena, Calif.

Dr. Robert A. Fuchs, a principal scientist and head of the systems analysis group, Space Defense Systems Division, Electro-Optical Systems, Inc., Pasadena, Calif.

David L. Wyand, manager of customer services, Eitel-McCullough, Inc., San Carlos, Calif.

W. Edward Boughton, formerly director of public relations for Trans World Airlines, has joined J. Walter Thompson Co. as a public relations supervisor and group head.

Leland C. Pleger, manager of the newly established Huntsville, Ala., field office of Aeronutronic Division of Ford Motor Co. Also: **Miles G. Wedeman,** assistant manager of Aeronutronic's Eastern Regional Office, Washington, D. C.

Patrick N. McDuffie, technical coordinator at the Army Redstone Arsenal, Huntsville, Ala., for General Precision Equipment Corp.

John A. Beckman, manager-communications and space projects, Houston Fearless Corp., Los Angeles, Calif. Also: **John N. MacDonald,** manager, Contracts Dept.

Hercules Powder Co.'s Chemical Propulsion Division, Wilmington, Dela., has announced the appointment of the following rocket and missile propellant specialists to the scientific staff of the Plans and Program Group: **Austin B. Chappelle, William D. Kelley, Jr.,** and **John A. Scherer.**

Douglas M. Copley, assistant congressional liaison officer, Office of Congressional Liaison, The Federal Aviation Agency, Washington, D. C.

Paul A. Lang, mechanical engineering manager, West Coast Division, Los Angeles, Calif., of Military Electronic Operations for Allen B. Du Mont Laboratories, Inc.

Professional Personnel Requisition

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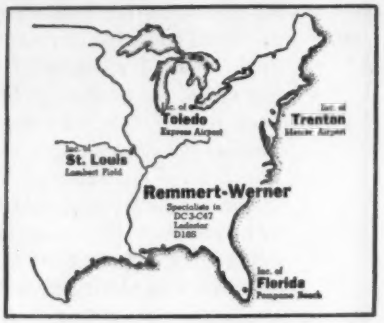

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AVIATION WEEK, DECEMBER 21, 1959

A.C. THE ELECTRONICS DIVISION OF G.M.C.... 54
AIRWORK CORP. 65
AMERICAN BOSCH ARMA CORP. 64
AMPEX CORP. 35
AUTONETICS, A DIVISION OF NORTH AMERICAN AVIATION INC. 78

BELL HELICOPTER CORP. 90
BENDIX RADIO DIVISION, BENDIX-AVIATION CORP. 48
BOEING AIRPLANE CO., WICHITA DIV. 96
BRUNSWICK-BALKE-COLLENDER CO. 8

CHANCE VOUGHT AIRCRAFT, INC. 70-71
COLVIN LABORATORIES, INC. 93
CONSOLIDATED FILM INDUSTRIES 88

DETREX CHEM. INDUS., INC. 86
DOUGLAS AIRCRAFT CO., INC. 40

THOM. A. EDISON, INSTRUMENTS DIV. McGRAW-EDISON 14
ETHIOPIAN AIRLINES, INC. 89
EX-CELL-O CORP. 4

FAIRCHILD CONTROLS CORP. 5
FUTURECRAFT DISTRIBUTION CORP. 91

GARRETT CORP. 66, 89, 93
GENERAL ANILINE & FILM CORP. 42
GENERAL ELECTRIC CO. 62
GENERAL MILLS, INC., MECHANICAL DIV. 52-53
GOODYEAR TIRE & RUBBER CO. 3

HAMILTON DIV. BENDIX AVIATION CORP. 84
HOLLEY CARBURETOR CO. 58-59

INTERNATIONAL BUSINESS MACHINES DATA PROCESSING 9
INTERNATIONAL NICKEL CO., INC. 56

KAMAN AIRCRAFT CORP. 51

LEAR, INC. 92
LISLE CORP. 67
LOCKHEED AIRCRAFT CORP. 74-75, 94

MD BLOWERS, INC. 85
METALS & CONTROLS DIV. 6
MILLER ELECTRIC MFG. CO. INC. 63
MISSILE DIVISION OF NORTH AMERICAN AVIATION 101

NATIONAL UTILITIES CORP. 91

PACIFIC SCIENTIFIC CO. 47
PIPER AIRCRAFT CORP. 80-81

RADIO CORP. OF AMERICA ..... 3rd Cover
RYAN AERONAUTICAL CO. 10

SERVOMECHANISMS, INC. ..... 4th Cover
SILICONES DIV., UNION CARBIDE CORP. 16
SOLAR AIRCRAFT CO. 46
STANDARD STEEL CORPORATION 7
STROMBERG-CARLSON ELECTRONICS 12

TASK CORPORATION 57
TELECOMPUTING CORPORATION 60
THIOKOL CHEMICAL CORP. 82
TUBE METHODS, INC. 70

U. S. STEEL CORP. 44-45

VOI SHAN MFG. CO. ..... 2nd Cover

WESTINGHOUSE ELEC. CORP. 38-39

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 97-99

EQUIPMENT
(Used or Surplus New)
For Sale 100

WANTED
Equipment 100

ADVERTISERS INDEX

CHEMSTRAND CORPORATION 100

EAST COAST AVIATION 100
ENGINE WORKS 100

HERCULES POWDER COMPANY 98
HONEYWELL, AERONAUTICAL DIVISION 99

INTERNATIONAL AIRCRAFT 100

MARQUARDT AIRCRAFT CORP. 97

PAUL, EDWARD K. 100

REMMERT-WERNER INC. 100

SOLAR AIRCRAFT COMPANY 98

WOLD ASSOC. WILLIAM C. 100

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MISSILE DIVISION
North American Aviation, Inc.

LETTERS

More Engine Data

We in the maintenance business here at Dover found your article on the YRC 600 engine (two moving parts) most provocative (AW Nov. 30, p. 33). So provocative, in fact, that we hope you will publish a sketch or schematic at your earliest convenience showing us how this engine works, so that several hundred mechanics and a number of "technical representatives" can go back to work!

(Name withheld by request.)
MAJOR
1607th Maintenance Group
(MATS)
United States Air Force
Dover AFB, Dela.

Your article, "Engine With Two Moving Parts Developed for Aircraft-Auto Use," p. 33, Nov. 30 issue, has aroused an intense interest among the engineers in our group. There is much speculation on the theory of operation, efficiency, reliability, and longevity of the rotating combustion engine.

Will you please send any additional information on this engine that you have available.

If not, will you tell me where it can be obtained.

A future article in AVIATION WEEK with a complete analysis of the rotating combustion engine would be most welcome.

LINN J. LEITNER
Flight Test Instrumentation Engineer
Convair Division of
General Dynamics Corp.
Holloman AFB, N. M.

(AVIATION WEEK has published all technical data available from Curtiss-Wright. We look forward to release of additional technical details on this engine.—Ed.)

Jet Noise Level

Lawrence Michels' letter in the Nov. 9 edition of your magazine, regarding his proposals to eliminate the jet noise problem around Los Angeles International Airport, calls for rebuttal in the form of factual comment.

Michels, who resides in Inglewood, a community east of the airport, and who is an electronics engineer for a major Santa Monica research company, has suggested that a maximum noise level be established for residential areas.

There is no yardstick available for such a level at this time, although the FAA is studying this problem. There seems to be varying opinions on the psychology of sound, perceived noise level, and decibel meter readings.

The point that Michels overlooked is that jet transports do meet the equivalent sound levels of piston type aircraft by the only means of sound measurement available. Unfortunately, the human ear does not react in the same manner as the decibel meter.

His suggestion that the performance of a jet engine be compromised in the interests

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

of noise abatement sounds fine on paper, but is highly impractical, as every airline operator knows.

To compromise engine performance is to ask the airlines to operate a "silent" aircraft that would carry no passengers, mail or express, or at best to reduce payload to the point that every flight would be a losing proposition.

Michels stated that airline revenue loss due to off-loading payload could be compensated by increased jet surcharges. Of course, the air traveling passenger would be asked to pay this surcharge. For the first time in an economy of rising costs and high taxes, it appears as though the jet transport is the vehicle for mass transportation by air because it will be possible to reduce fares. Make the jet fares high enough and the big transports will stay on the ground and the Jet Age will become null and void.

Michels pointed out that "The jet airliners were purchased for use at existing airfields, many of which are located adjacent to residential areas, as is LA International."

He stated the facts incorrectly. Los Angeles International had its origin in 1928 and there were no residential areas of any consequence near this terminal at that time. The build-up of homes and factories occurred after the airport was established and developed, and the build-up continues unabated.

Development of LA International was contingent upon the advent of the jets—not the sound of these new transports, as Michels states.

His comment on how efficient noise suppressors "can be readily designed and constructed at the present time..." has brought forth this response from William M. Allen, president of the Boeing Airplane Co.:

"The Boeing Company established a design requirement to incorporate effective sound suppressors on the 707 jet transport prior to the time the airplane had been purchased by a commercial airline.

"Our design, development and production of the suppresssor units to date has cost over $10 million. These devices achieve a reduction of approximately 10 decibels, which considerably exceeds our original expectations.

"Airplane operating losses have been kept within reasonable limits, but any further significant reduction in sound during flight with present technology would be accompanied by extreme penalties to the economics of airplane operation.

"The proposal . . . does not show any appreciation for the technological and economic problems involved, and in our opinion is inequitable and impractical."

And, W. P. Gwinn, president of United Aircraft Corp., had this to say, in part, on Michels' proposal:

"The results of test work on suppressors has shown that the reduction in noise with flight type suppressors is accompanied by a loss in engine and aircraft performance and that the reduction in noise is not in a straight line relationship to these losses.

"The reduction in noise in a typical system reaches a point where the losses become asymptotic and the whole system becomes useless as a flight article because a point of no return in reduced sound level as perceived on the ground is reached.

"We believe that the problem of aircraft noise is one that must be solved by continued effort and understanding. The aircraft industry and the airlines will do their utmost to control sound level by suppression devices and improved operating techniques.

"The affected segments of the public can assist by gaging their reaction to the sound levels against the tremendous economic benefits and new vistas of comfort and convenience represented by modern aircraft."

TOM TOWERS, DIRECTOR
Los Angeles Sound Abatement
Coordinating Committee

Retirement Age

I have been following with interest the letters in your columns regarding the controversial rule proposed by the FAA to retire pilots at age 60. Though there are exceptions to every general rule, it is a fact of life, no matter how partisan one may be, that people over 55 are not as "sharp" as they were when they were 40. Shell Oil Co. retires most of their executives at 55, generals and master sergeants leave the Army at a prescribed age, and some of the greatest athletes of our generation like Gene Tunney and Gene Sarazen are no longer in the ring nor play tournament golf.

Couldn't the controversy be resolved by stipulating that pilots over 55 could continue to fly as long as they wished so long as they qualified physically and professionally but limited to flying the freight planes. Up to that age they could fly the passenger services. This way, should a plane be lost due to pilot error attributed to age, only replaceable freight and a small crew would be lost, not the 100 or more riding in a modern jet.

J. R. McMICKING
San Francisco, Calif.

Pilot Pay

Just finished reading the tragic story of the Delta pilot with a whole month seniority being forced to fly a bad old DC-7 for a miserable $1,845 per month (AW Nov. 2, p. 21).

How long will America tolerate such flagrant abuse of pilots rights? Let us do something to protect the poor pilots from such unfair practices by the ALPA seniority board. With sympathy,

S. E. COOPER, Paying Passenger
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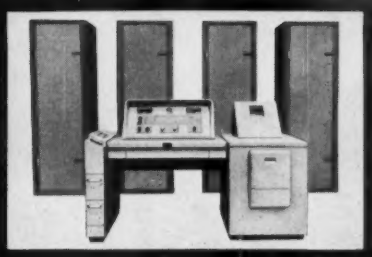

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The system being supplied to Convair for the ATLAS Program includes a console and four rack cabinets providing both analog and discrete test functions with a resulting printed and GO-NO GO indication. As a product of RCA's Missile Electronics and Controls Department, Burlington, Massachusetts, APCHE is one of the latest RCA developments in the field of military weapon readiness equipments.

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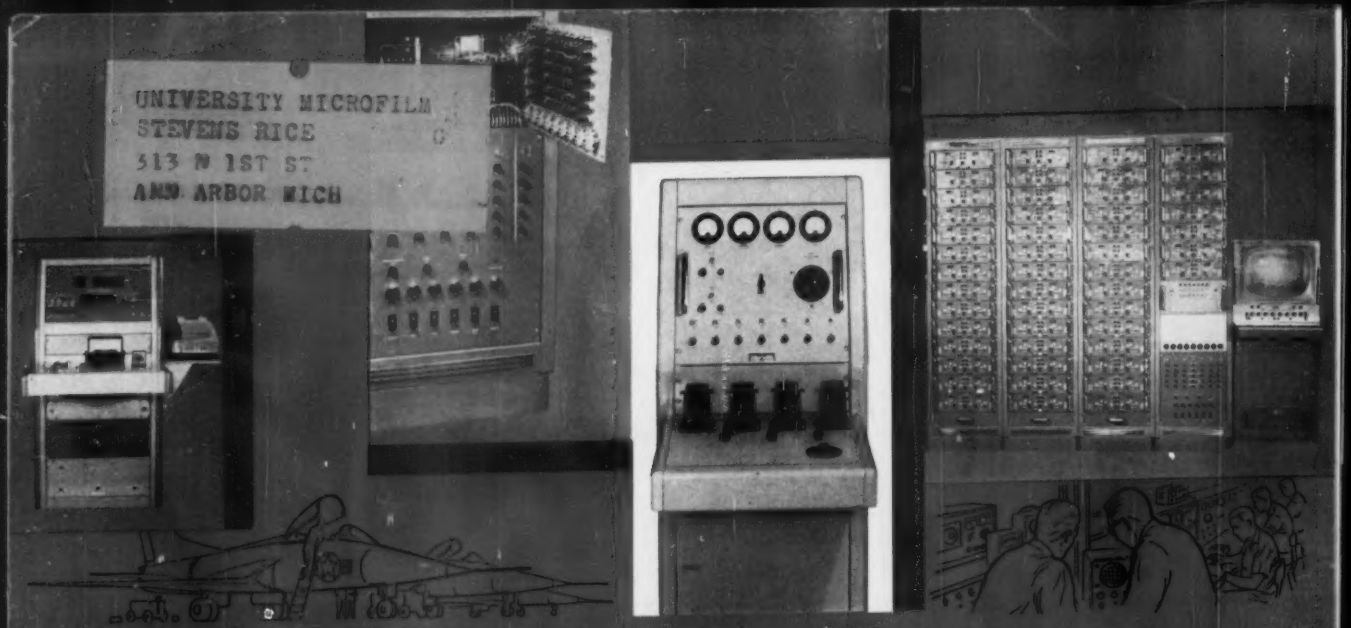

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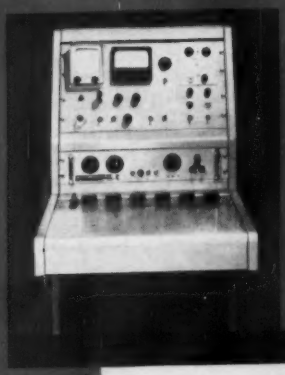

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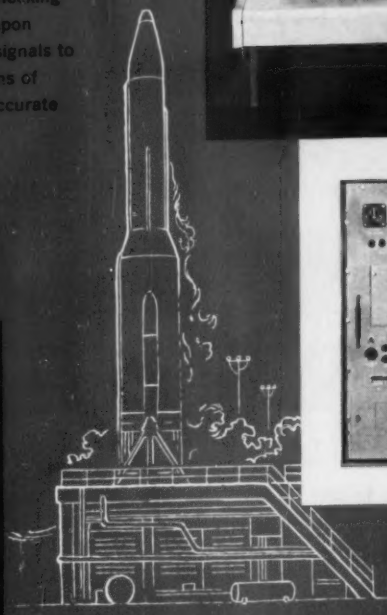

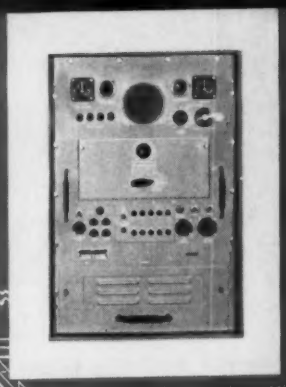

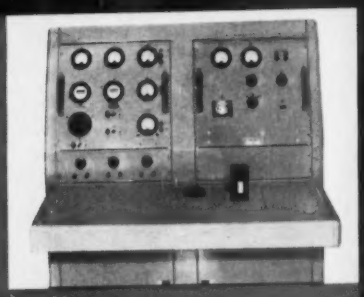

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